North Carolina Department of Transportation
Statewide Planning Branch
Small Urban Planning Unit

August, 1994

THOROUGHFARE PLAN
FOR THE
TOWN OF MOUNT OLIVE

Prepared by the:
Statewide Planning Branch
Division of Highways
North Carolina Department of Transportation

In Cooperation with:
The Town of Mount Olive
The Federal Highway Administration
U. S. Department of Transportation

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Chapter 1

INTRODUCTION

This report documents the findings of a study of Mount Olive's Thoroughfare system that began in 1993 and culminated in the mutual adoption of an updated Mount Olive Thoroughfare Plan.

The primary objective of thoroughfare planning is to enable the urban street system to be progressively developed to adequately service future traffic demands. The benefits of thoroughfare planning are detailed in Chapter 8.

Mount Olive is located in Wayne County, in southeast North Carolina. Goldsboro is located approximately 9.3 km (15.0 mi) north. Mount Olive was formed around the Seaboard Coast Line Railroad, which runs through the center of Town. The Town is also the home the Mount Olive Pickle Plant and Mount Olive College.

Before the Town Council and the North Carolina Department of Transportation adopted this Thoroughfare Plan, a 1981 Thoroughfare Plan was in force. However, little of the new construction and proposed widening in the older plan had been completed. The major construction item in the 1981 plan that was implemented was the realignment of Smith Chapel Road (SR 1157) to tie in with Smith Chapel Highway (SR 1147) at the US 117 Bypass.

The 1981 Thoroughfare Plan proposed an Outer Loop that ran south and east of town. The proposed relocation of Carver Elementary School to Old Seven Springs Road, near the proposed Outer Loop, prompted Town officials to request an update of the 1981 Thoroughfare Plan. The Town was interested in the implementation of a portion of the Outer Loop near the proposed Elementary School.

Other problems also led to the Town requesting a thoroughfare plan update. The Central Business District (CBD) of Mount Olive has parking and circulation problems partially associated with the Seaboard Coast Line Railroad, which runs through the middle of the CBD. Also, the two-lane section of Breazeale Avenue is heavily traveled, and the Town wanted to alleviate congestion.

To ensure that the recommendations of the study were comprehensively considered and consistent with the desires of the local citizens, a thoroughfare planning committee was appointed by the Town of Mount Olive. This committee met several times to review and provide input made during the study.

Basic thoroughfare planning principles, as described in Chapter 8, were used to develop this plan. It is based on existing traffic, population, and land use data. Year 2020 average daily traffic projections were used to determine capacity deficiencies. The adopted thoroughfare plan is expected to meet the traffic demands of Mount Olive for the planning period of 1992 - 2020. Some major highlights of the 1994 Mount Olive Thoroughfare Plan are:

1) The **Outer Loop** will provide access to the southern and eastern parts of town, as well as the proposed Carver Elementary School.

2) A portion of **Breazeale Avenue (US 117 Business)** is anticipated to be over capacity in 2020. To increase capacity, it is recommended that the section of Breazeale Avenue between County Road (SR 1947) and Station Street be widened to 36' to accommodate a three lane section with a center two-way left turn lane.

3) **Main Street (SR 1141/11004) and James Street (SR 1004)** should be combined into a one-way pair. The pair should run between the James/Main intersection to Wooten Street. Slight realignments will be needed at Wooten Street to ease transition from James to Main Street.

4) **Williamson Street** should be grade improved at the Seaboard Railroad crossing. Also, minor improvements to the alignment at Martin Street, with stop control shifted to Martin Street, will benefit this route.

5) **Center Street** should have an uniform parking layout throughout the center of the CBD. All angled parking should be shifted to storefront. At selected points, parking should be removed to improve sight distance. To reduce through traffic and lower speeds, it is recommended that stop control be shifted to Center Street in the CBD. It is also recommended that Center Street be realigned at College Street to allow for smooth flow.

The North Carolina Department of Transportation and the Town of Mount Olive are jointly responsible for the proposed thoroughfare improvements. Cooperation between the state and local government is of primary concern. The plan has been mutually adopted by all parties and it is the responsibility of the local government body to implement the plan following the guidelines set forth in Chapter 3.

It should be emphasized that the recommended plan is based on anticipated growth of the urban area as indicated by current trends. Prior to construction of specific projects, a more detailed study will be required to reconsider development trends and to determine specific locations and design requirements.

Geographic Location

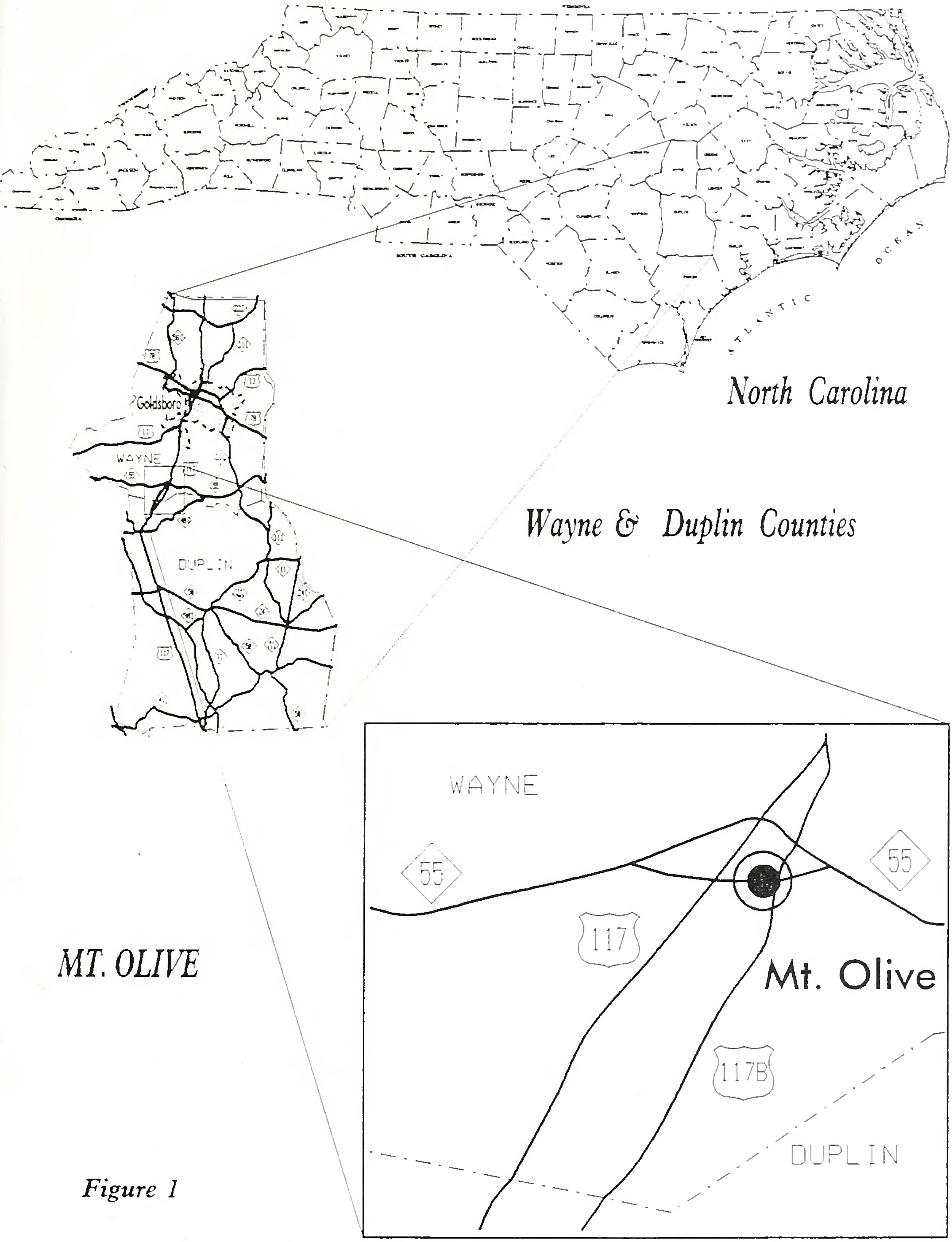

Figure 1

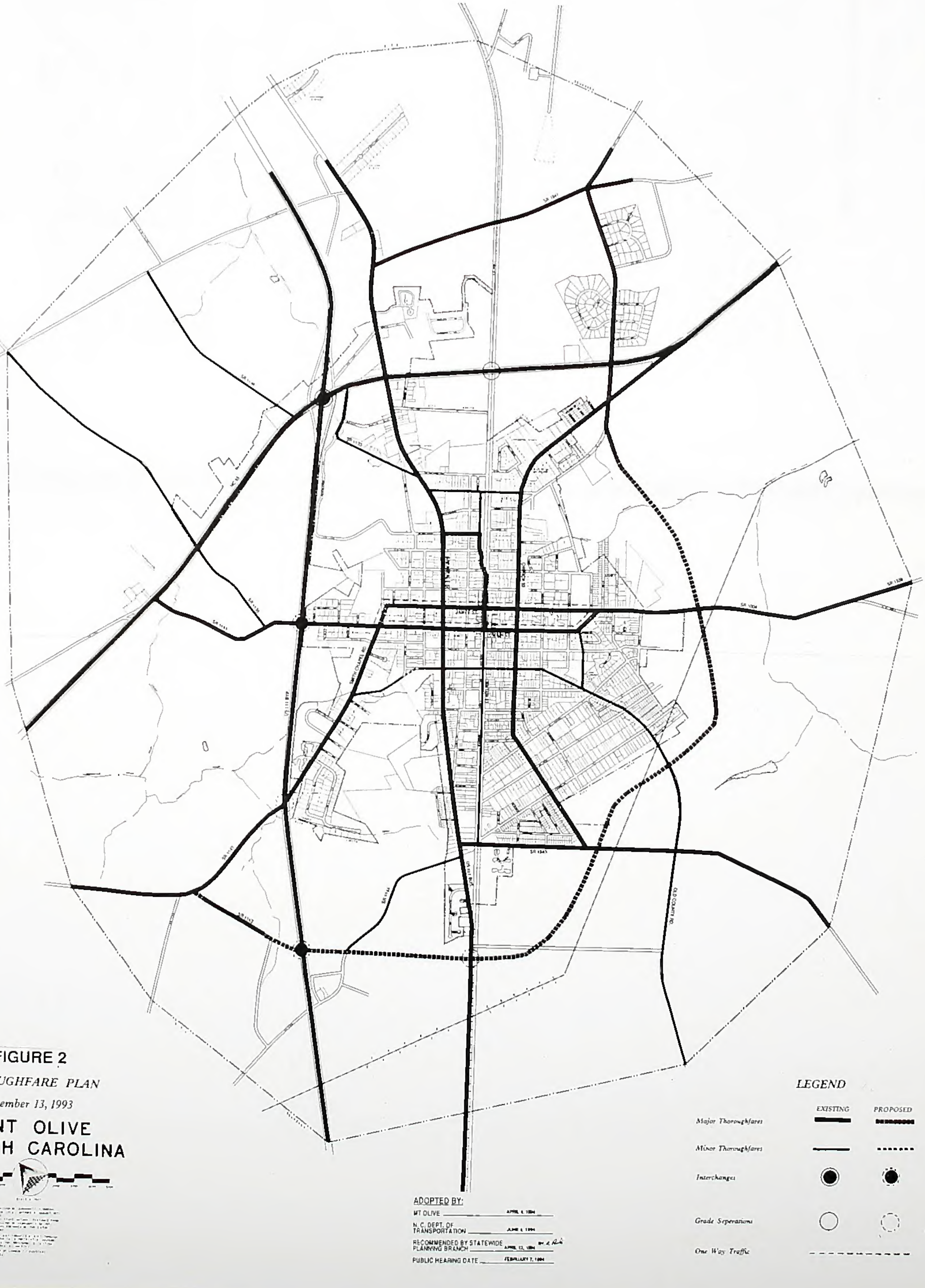

FIGURE 2

THOROUGHFARE PLAN

December 13, 1993

MOUNT OLIVE
NORTH CAROLINA

Chapter 2

RECOMMENDED THOROUGHFARE PLAN

A thoroughfare plan study uncovers the need for new facilities, plus identifies existing and future deficiencies in the transportation system. The thoroughfare plan is a representation of the existing highway system by functional use, e.g., major thoroughfares, minor thoroughfares plus any new facilities that are needed. The planning methodology enables identification of deficiencies in the existing system, allowing compilation of a list of needed improvements.

This chapter presents an analysis and makes recommendations based on the ability of the existing street system to serve present and future travel desires as the area continues to grow. The usefulness of transportation planning is in the analysis of different highway configurations for their efficiency in serving the area. The recommended plan sets forth a system of thoroughfares to serve the anticipated traffic and land development needs for the Mount Olive area. The need to eliminate existing and projected system deficiencies that cause traffic congestion is the primary objective of the plan.

This plan is the revised version of the 1981 Thoroughfare Plan. The recommended revisions are based on the results of a traffic forecast model that uses data on traffic counts, population, housing, employment, and vehicle ownership to simulate travel (see Chapter 7). With this model each major street and highway in the planning area is analyzed to determine its ability to serve existing and future traffic demands. In the development of an updated thoroughfare plan, it was found that some proposals from the old thoroughfare plan have been implemented. Some were found inadequate for current problems and were dropped. Some new proposals were added for the updated thoroughfare plan.

Updated Thoroughfare Plan Recommendations

The process of developing, testing and evaluating alternate plans involved several considerations. These included Mount Olive's goals and objectives, identified deficiencies (see Chapter 4), environmental impacts, existing and anticipated land development, and travel services. Aerial photography, topographic mapping, field reconnaissance and discussion with local staff, officials and interested local citizens provided additional basis for identifying and evaluating alternate alignments. The following is a list of the recommendations for the Mount Olive Planning Area:

Major Thoroughfare System

The roadways serving as major thoroughfares are the primary traffic arteries of the urban area. The major thoroughfares of Mount Olive are composed of crosstown routes, major radials, and complete bypass routes. The following existing streets and proposed facilities are classified accordingly.

Bypass System

Outer Loop - A proposed Outer Loop will provide access to the southern and eastern parts of town. As the 1981 Thoroughfare Plan proposed, the Mount Olive Outer Loop would provide additional convenience to the traveling public and relieve pressure on the US 117 Bypass - NC 55 interchange. The proposed Carver Elementary School will be located near Old Seven Springs Road, and the outer loop. The outer loop will provide improved access to the school. The Outer Loop is recommended to be a standard two-lane section on 30 m (100 ft) of right-of-way.

The 1994 Thoroughfare Plan Outer Loop has been slightly realigned from the 1981 plan. The southern part of the loop near Breazeale Avenue has been shifted south to avoid impacting a neighborhood.

US 117 Bypass - This route moves north-south traffic along the western edge of Mount Olive. It is anticipated that the US 117 Bypass will be adequate through the design year.

A study is currently in progress to examine the feasibility of upgrading US 117 to a full control of access facility, and making it a major connector between Wilson and I-40. This project would also improve access to the Global Transpark Area to be built near Kinston. Project R-606 on US 117 from NC 55 to I-40 is only one portion of the project to upgrade the entire length of US 117. The improvement of US 117 would require a diamond interchange at the Main Street and the proposed Outer Loop intersections. The intersection with Smith Chapel Highway (SR 1157) should be a grade separation.

NC 55 - This route allows east-west traffic to pass north of Mount Olive. It is anticipated that NC 55 will be adequate through the design year. NC 55 also connects Mount Olive with Kinston, therefore, careful monitoring of the traffic on NC 55 is recommended to avoid congestion from Global Transpark Area traffic.

Crosstown System

Breazeale Avenue (US 117 Alternate) - This facility is a north-south facility providing crosstown service west of the CBD. The Mount Olive model did not predict a significant increase in traffic on most of the route, due to the growth mainly outside of Town. As traffic increases on Breazeale Avenue, some traffic should shift over to US 117 Bypass. However, if the traffic shift does not occur, some two-lane sections of Breazeale Avenue could reach capacity. The Mount Olive model does predict that the section between Main and Station Streets will be near capacity in the design year.

To increase safety and capacity, it is recommended that the section of Breazeale Avenue between County Road (SR 1947) and Station Street be widened to a 11 m (36 ft) section to accommodate a three-lane facility with a center two-way left turn lane. Much of the two-lane section of Breazeale Street in Town is in a historic district.

Church Street - This route is also a north-south facility providing crosstown service. By widening Church Street to a 8 m (24 ft) two-lane urban section, it will adequately provide traffic service through the design year.

Main Street (SR 1141/1004) and James Street (SR 1004) - The one-way pairing of these facilities are proposed to carry east-west crosstown traffic through the CBD. Some areas of James Street and Main Street east of the CBD are anticipated to be over capacity in the design year. Making these routes a one-way pair will create additional capacity that will provide adequate traffic service through the design year. It is recommended that Main Street run east and James Street west. The one-way pair should extend from the James/Main Intersection to Wooten Street. Wooten Street will need to be slightly realigned to allow the one-way pair to operate smoothly. One house is expected to be impacted with the Wooten Street realignment. The one-way pair also will alleviate some operational problems in the CBD.

It is also recommended that James Street be widened to a 8 m (24 ft) cross section east of the one-way pair to increase safety and capacity.

Center Street (between Main Street and Henderson) - This portion of Center Street is a local street providing access to the CBD. Center Street is divided by the Seaboard Coast Line Railroad. The existing cross section will provide adequate service through the design period. However, it is recommended that at selected

points parking be removed to improve sight distance. A uniform parking layout throughout the length of the CBD is recommended. Angled storefront parking will provide patrons the optimum access to downtown businesses.

To reduce through traffic and lower speeds, it is recommended that stop control be shifted to Center Street at the James and Main intersections. This will allow the James/Main one-way pair to provide acceptable levels of service, while shifting north-south through traffic to Church Street or Breazeale Streets.

Other sections of Center Street not between Main and Henderson are considered Minor Thoroughfares, and are covered in the appropriate section.

Henderson Street - This facility is a major connector between the downtown area and shopping areas located on Breazeale Avenue. The capacity of this route is expected to be adequate through the design year.

Radial Streets

The radial system is primarily a series of secondary routes that funnel traffic to the center of Mount Olive. This system only requires widening to a standard two-lane rural section. Since no right-of-way is purchased along secondary routes, it is proposed that many of these facilities be widened to standard sections in conjunction with resurfacing projects. Additional information on capacity and lane widths are covered in Chapter 4. The routes comprising this system are:

(1) West Main Street (SR 1141)

(2) Smith Chapel Road (SR 1147)

(3) Beautancus Road (SR 1306) - Widen to 6.1 m (20 ft)

(4) Northeast Church Road (SR 1941) - Widen to 6.7m (22 ft)

(5) County Road (SR 1947)

Minor Thoroughfare System

The roadways serving as minor thoroughfares collect traffic from local access streets in the Mount Olive Planning Area and carry it to the major thoroughfares.

Center Street (north of Henderson and south of Main) - These portions of Center Street are minor thoroughfares providing access to the CBD. The entire length of

Center Street is divided by the Seaboard Coast Line Railroad. The sections listed as minor thoroughfares are expected to be sufficient through the design year.

Williamson Street - This route is an east-west thoroughfare. Minor improvements to the alignment at Martin Street and the railroad will be necessary if Williamson Street is to realize its full potential. Stop control should be shifted to Martin Street to allow for smooth, uninterrupted flow on Williamson Street. An expected grade adjustment at the Seaboard Railroad crossing also will increase the benefits of using Williamson Street.

The following minor thoroughfares are expected to be adequate throughout the design year.

(1) Gordon Street

(2) Park Avenue (SR 1744)

(3) Jones Grove Church Road (SR 1135)

(4) Doughtery Field Road (SR 1143)

(5) Lee's Country Club Road (SR 1144)

(6) Martin Road (SR 1146)

(7) Oliver Street

(8) Mount Gilead Church Road (SR 1318)

(9) Old County Road (SR 1947)

Traffic Operations

In the design year, 2020, the US 117 Bypass and NC 55 are expected to be receiving much higher amounts of traffic than they are currently experiencing, which the computer model demonstrates. The areas receiving the most growth are located in the western and northern parts of town, which these routes serve.

The computer model shows some sections of Breazeale Avenue may experience a slight drop in traffic in the design year. US 117 Bypass and Breazeale Avenue are nearly parallel routes. The areas which Breazeale Avenue serves are not expected to significantly grow, because these areas are near their maximum development potential. The areas near US 117 Bypass are expected to grow, therefore they will be generating more traffic. The "magnets" of the 2020 model are pulling trips away from the center of town to the outskirts

of Town where they use US 117 Bypass and NC 55. US 117 Bypass is a much quicker north-south route than Breazeale Avenue because it is a partially accessed controlled facility. Also, as Breazeale Avenue becomes more congested, traffic will shift to the US 117 Bypass. If the planned upgrade of US 117 to a controlled access facility is implemented, the shift of north-south traffic to it may occur at a faster rate.

The computer model shows a slight increase in traffic on Main Street. This will continue to be the main east-west route in town. NC 55, the major east-west route, is too far away from Main Street to have a significant impact on through traffic.

Chapter 3

IMPLEMENTATION OF THE THOROUGHFARE PLAN

Implementation is one of the most important aspects of the transportation plan. Unless implementation is an integral part of this process, the effort and expense associated with developing the plan is lost. There are several tools available for use by the Town to assist in the implementation of the thoroughfare plan. They are as follows:

State-Municipal Adoption of the Thoroughfare Plan

The Town of Mount Olive and the North Carolina Department of Transportation should mutually approve the thoroughfare plan shown in Figure 2. The mutually approved plan may then serve as a guide for the Department of Transportation in the development of the road and highway system for the Town. The approval of the plan by the Town also enables standard road regulations and land use controls to be used effectively in the implementation of this plan. As part of the plan, the Town and Department of Transportation shall reach agreement on the responsibilities for existing and proposed streets and highways. Facilities which are designated a State responsibility will be constructed and maintained by the Division of Highways. Facilities which are designated a municipal responsibility will be constructed and maintained by the municipality.

Subdivision Controls

Subdivision regulations require every subdivider to submit to the County Planning Commission a plan of any proposed subdivision. It also requires that subdivisions be constructed to certain standards. Through this process, it is possible to require the subdivision streets to conform to the thoroughfare plan and to reserve or protect necessary right-of-way for projected roads and highways that are to become a part of the thoroughfare plan. The construction of subdivision streets to adequate standards reduces maintenance costs and simplifies the transfer of streets to the State Highway System. Appendix C outlines the recommended subdivision design standards as they pertain to road construction.

Land Use Controls

Land use regulations are an important tool in that they regulate future land development and minimize undesirable development along roads and highways. The land use

regulatory system can improve highway safety by requiring sufficient setbacks to provide for adequate sight distances and by requiring off-street parking.

Development Reviews

Driveway access to a State-maintained street or highway is reviewed by the District Engineer's office and by the Traffic Engineering Branch of the North Carolina Department of Transportation. In addition, any development expected to generate large volumes of traffic (e.g., shopping centers, fast food restaurants, or large industries) may be comprehensively studied by staff from the Traffic Engineering Branch, Planning and Environmental Branch, and/or Roadway Design Unit of NCDOT. If done at an early stage, it is often possible to significantly improve the development's accessibility while preserving the integrity of the thoroughfare plan.

Funding Sources

Capital Improvements Program

A capital improvement program makes it easier to build a planned thoroughfare system. This capital improvement program consists of two lists of projects. The first is a list of highway projects that are designated as a municipal responsibility and are to be implemented with municipal funds. The second is a list of local projects designated as State responsibility to be included in the Transportation Improvement Program.

Transportation Improvement Program

North Carolina's Transportation Improvement Program (TIP) is a document which lists all major construction projects the Department of Transportation plans for the next seven years. Similar to local Capital Improvement Program projects, TIP projects are matched with projected funding sources. Each year when the TIP is updated, completed projects are removed, programed projects are advanced, and new projects are added.

During annual TIP public hearings, municipalities request projects to be included in the TIP. A Board of Transportation member reviews all of the project requests in a particular area of the state. Based on the technical feasibility, need, and available funding, the board member decides which projects will be included in the TIP. In addition to highway construction and widening, TIP funds are available for bridge replacement

projects, highway safety projects, public transit projects, railroad projects, and bicycle projects.

Industrial Access Funds

If an Industry wishes to develop property that does not have access to a state maintained highway and certain economic conditions are met, then funds may be made available for construction of an access road.

Small Urban Funds

Small Urban funds are annual discretionary funds made to municipalities with qualifying projects. The maximum amount is $300,000 per year per project. A Town may have multiple projects. Requests for Small Urban Fund assistance should be directed to the appropriate Board of Transportation member and Division Engineer.

The North Carolina Highway Trust Fund Law

The Highway Trust Fund Law was established in 1989 as a 13.5 year plan with four major goals for North Carolina's roads and highways. These goals are:

1. To complete the remaining 2767 km (1,716 mi) of four lane construction on the 5806 km (3,600 mi) North Carolina Intrastate System.

2. To construct a multilane connector in Asheville and portions of multilane loops in Charlotte, Durham, Greensboro, Raleigh, Wilmington, and Winston-Salem.

3. To supplement the secondary roads appropriation in order to pave, by 1999, 16,100 km (10,000 mi) of unpaved secondary roads carrying 50 or more vehicles per day, and all other unpaved secondary roads by 2006.

4. To supplement the Powell Bill Program.

In this 28-year planning period, Mount Olive should look forward to the paving of most, if not all, of its unpaved roads on the State maintained system in the Planning Area. Also, there will be and increase in Mount Olive's Powell Bill Funds if these newly paved roads are in the Mount Olive Corporate Limits.

For more information on the Highway Trust Fund Law, contact the Program Development Branch of the North Carolina Department to Transportation.

Table 1

Funding Sources and Methods Recommended for Implementation of Projects

PROJECT	Funding Sources				Methods of Implementation				
	Local Funds	TIP Funds	Indust. Access	Small Urban	T-fare Plan	Subdiv. Ord.	Zoning Ord.	Future Street Lines	Development Review
1) Outer Loop		X			X	X	X		X
2) Breazeale Ave. (Chestnut St.-Station St.)		X			X				X
3) Breazeale Ave. (Three lane extension)		X			X	X	X		X
4) Main/James One-Way Pair	X			X	X				X
5) Williamson St.	X				X				X
6) Center Street	X				X				X

Construction Priorities and Cost Estimates

Construction priorities will vary depending on what criteria are considered and what weight is attached to the various criteria. Most people would agree that improvements to the major thoroughfare system and major traffic routes would be more important than minor thoroughfares where traffic volumes are lower. To be in the North Carolina Transportation Improvement Program, a project must show favorable benefits relative to costs and should not be prohibitively disruptive to the environment. The potential cost estimate of four Mount Olive projects with respect to the user benefits, probability that economic development will be stimulated and environmental impacts are given in Table 3.

Reduced road user cost should result from any roadway improvement, from a simple widening to the construction of a new roadway to relieve congested or unsafe conditions. Comparisons of the existing and the proposed facilities have been made in terms of vehicle operating costs, travel time costs, and accident costs. These user benefits are computed as total dollar savings over the 30 year design period using data such as project length, base year and design year traffic volumes, traffic speed, type of facility, and volume/capacity ratio.

The impact of a project on economic development potential is shown as the probability that it will stimulate the economic development of an area by providing access to developable land and reducing transportation costs. It is a subjective estimate based on the knowledge of the proposed project, local development characteristics, and land development potential. The probability is rated on a scale from 0 (none) to 1.00 (excellent).

The environmental impact analysis considers the effect of a project on the physical, social/cultural, and economic environment. Below are listed the thirteen items that are considered when evaluating the impacts on the environment. They are: (1) air quality, (2) water resources, (3) soils and geology, (4) wildlife, (5) vegetation, (6) neighborhoods, (7) noise, (8) educational facilities, (9) churches, (10) parks and recreational facilities, (11) historic sites and landmarks, (12) public health and safety and (13) aesthetics. The summation of both positive and negative impact probabilities with respect to these factors provides a measure of the relative environmental impacts of a project.

Offsetting the benefits that would be derived from any project is the cost of its construction. A new facility, despite its high projected benefits, might prove to be unjustified due to the excessive costs involved in construction. The highway costs estimated in this report are based on the average statewide construction costs for similar

construction. The highway costs estimated in this report are based on the average statewide construction costs for similar project types. An estimate of anticipated right-of-way costs is also included. Table 3 evaluates the proposed Mount Olive projects with respect to user benefits, estimated costs, probability of economic development, and environmental impact. Table 2 may be used as a guideline for interpreting the "Probable Impact" values in Table 4.

Table 2

Probability Estimation Guide

Subjective Evaluation	Impact Probability
Excellent - very substantial	1.00
Very good - substantial	0.75
Good - considerable	0.50
Fair - some	0.25
Poor - none	0.00

Table 3

Potential Project Cost Estimates For Investigated Projects

Project	Project Description	R/W Cost	Construct.	Total Cost
1	Outer Loop	$ 153,000	$ 6,040,000	$ 6,193,000
2	James/Main One-Way Pair	$ 72,000	$ 114,000	$ 186,000
3	Breazeale Avenue Widening to 3-Lanes	$ 2,000	$ 160,000	$ 162,000
4	Williamson Street Alignment Improvem.	$ 3,000	$ 95,000	$ 98,000

* = cost estimates for Mount Olive Planning Area only

Table 4

Benefits Evaluation for Major Projects

Project	Benefits (1000's)	Costs (1000's)	Length (mile)	Benefits per Mile (1000's)	Economic Developmt. Potential	Eviron. Impact
1) Outer Loop	$ 13,822	$ 6,193	4.20	$ 3,291	0.50	+0.75 -0.25
2) James/ Main	$ 4,834	$ 186	0.94	$ 5,142	0.25	+0.50 -0.25
3) Breaz. Widening	$ 1,147	$ 162	0.32	$ 3,585	0.00	+0.25 -0.25

Chapter 4

TRAVEL DEFICIENCY ANALYSIS OF EXISTING SYSTEM

This chapter presents an analysis of the ability of the existing street system to serve the area's travel desires. Emphasis is placed not only on detecting the deficiencies, but on understanding their cause. Travel deficiencies may be localized and the result of substandard highway design, inadequate pavement width, or intersection controls. Alternately, the underlying problem may be caused by the system deficiency such as a need for a bypass, loop facility, construction or missing links, or additional radials.

Existing Travel Patterns

An indication of the adequacy of the existing major street system is a comparison of the traffic volumes with the ability of the streets to move traffic freely at a desirable speed. The ability of a street to move traffic freely, safely, and efficiently with a minimum delay is controlled primarily by the spacing of major devices utilized. Thus, the ability of a street to move traffic can be increased by restricting parking and turning movements, using proper sign and signal devices, and by the application of other traffic engineering techniques.

Capacity is the maximum number of vehicles that has a reasonable expectation of passing over a given section of a roadway in one direction, or in both directions, during a given period under prevailing roadway and traffic conditions.[1] The relationship of traffic volumes to the capacity of the roadway will determine **level of service** being provided. Six levels of service have been selected for analysis purposes. They are given letter designations from A F. Level-of-service (LOS) A represents the best operating conditions and level-of-service F the worst.

The six levels of service are illustrated in Figure 3, and they are defined in Table 5. The definitions are general and conceptual in nature, but may be applied to urban arterial levels of service. Levels of service for interrupted flow facilities vary widely in terms of both the user's perception of service quality and the operational variables used to describe them. The 1985 Highway Capacity Manual contains more detailed descriptions of the levels of service as defined for each facility type.

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[1] Highway Capacity Manual, Special Report 209, 1-3, 1985

Table 5

Level of Service

LOS A - describes primarily free flow-operations at average travel speeds usually about 90 percent of the free-flow speed for the arterial class. Vehicles are completely unimpeded in their ability to maneuver within the traffic stream. Stopped delay at signalized intersections is minimal.

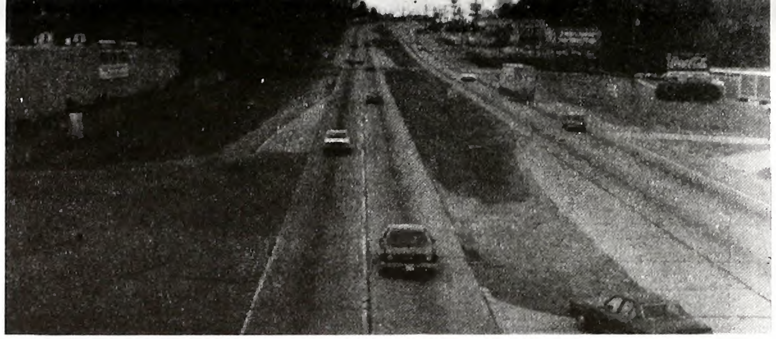
LOS B - represents reasonable unimpeded operations at average travel speeds usually about 70 percent of the free-flow speed for the arterial class. The ability to maneuver within the traffic stream is only slightly restricted and stopped delays are not bothersome. Drivers are not generally subjected to appreciable tension.

LOS C - represents stable operations. However, ability to maneuver and change lanes in mid-block locations may be more restricted than in LOS B, and longer queues and/or adverse signal coordinations may contribute to lower average travel speeds of about 50 percent of the average free-flow speed for the arterial class. Motorists will experience an appreciable tension while driving.

LOS D - borders on a range on which small increases in flow may cause substantial increases in approach delay and, hence, decreases in arterial speed. Delay may be due to adverse signal progression, inappropriate signal timing, high volumes, or some combination of these. Average travel speeds are about 40 percent of free-flow speed.

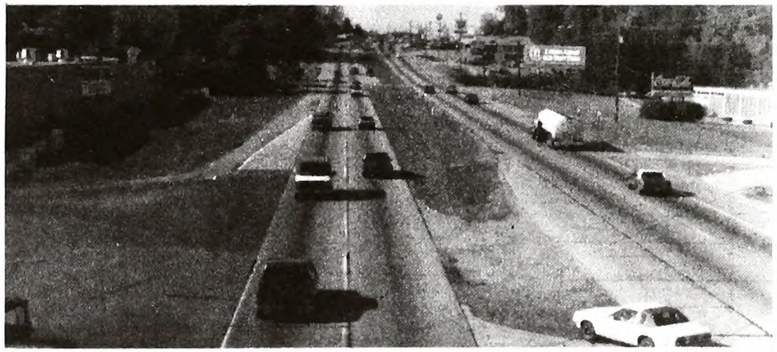
LOS E - The boundary between LOS D and LOS E describes operation at **capacity**. Operations at this level are extremely unstable, because there are almost no gaps in the traffic stream. Any disruption to the traffic stream, such as a vehicle entering from a ramp, or changing lanes, requires the following vehicles to give way to admit the vehicle. This condition establishes a disruption wave that propagates through the upstream traffic flow. At capacity, the traffic stream has no ability to dissipate any disruption. Any incident can be expected to produce a serious breakdown with extensive queuing.

LOS F - describes forced or breakdown flow. The arterial flow is at extremely low speeds - below one-third to one-quarter of the free-flow speed. Intersection congestion is likely at critical signalized locations, with high approach delays resulting. Adverse progression is frequently a contributor to this condition.



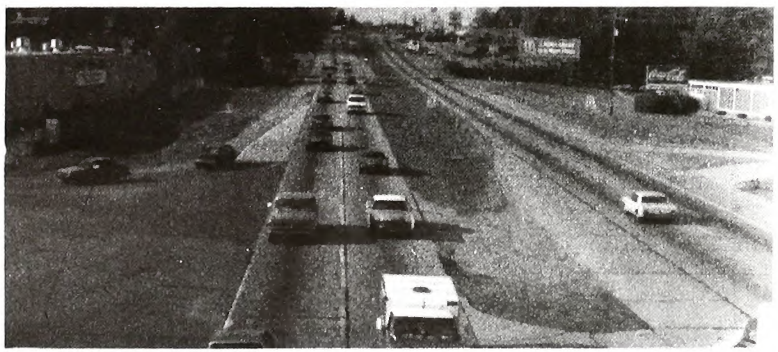
LEVEL OF SERVICE - A

LEVEL OF SERVICE - D



LEVEL OF SERVICE - B

LEVEL OF SERVICE - E



LEVEL OF SERVICE - C

LEVEL OF SERVICE - F

LEVELS OF SERVICE

FIGURE 3

Traffic Accidents

High Accident Locations are very important to a thoroughfare plan. Traffic accident records are of assistance in defining problem areas and often pinpoint a deficiency such as poor design, inadequate signing, ineffective parking, or poor sight distance. Accident patterns developed from analysis of accident data can lead to remedial action reducing the number of accidents.

Both the severity and number of accidents should be considered when investigating accident data. The severity of every accident is measured with a series of weighting factors developed by NCDOT's Division of Highways. In terms of these factors, a fatal or incapacitating accident is 47.7 times more severe than one involving only property damage. An accident resulting in minor injury is 11.8 times more severe than one with only property damage. Table 6 is a summary of accidents in Mount Olive from 7/1/89 to 6/30/92.

The "Total" column indicates the total number of accidents reported within one hundred (100) feet of the intersection during the indicated time period. The severity listed is the average accident severity for that location.

Table 6

Accident Summary 07/01/89 to 06/30/92

	LOCATION	TOTAL	SEVERITY
1.	Breazeale and Main	14	3.59
2.	Church and Main	13	6.57
3.	NC 55 and Breazeale	12	10.78
4.	Breazeale and Henderson	11	9.23
5.	Breazeale and James	10	6.43
6.	Center and James	10	4.62
7.	US 117 and Smith Chapel	9	37.04
8.	US 117 and Jones Grove Church Road	9	15.08
9.	Church and James	8	13.40
10.	Center and Main	7	3.59
11.	Breazeale and Pollock	6	7.03
12.	Church and Maple	6	4.02
13.	Church and Frank	5	11.86
14.	Church and College	5	17.22

1992 Traffic Capacity Analysis

Figure 4 depicts the base year (1992) major street system and the ADT (Average Daily Traffic). A comparison of the base year ADT to capacities does not reveal any streets near or over practical capacity (LOS D).

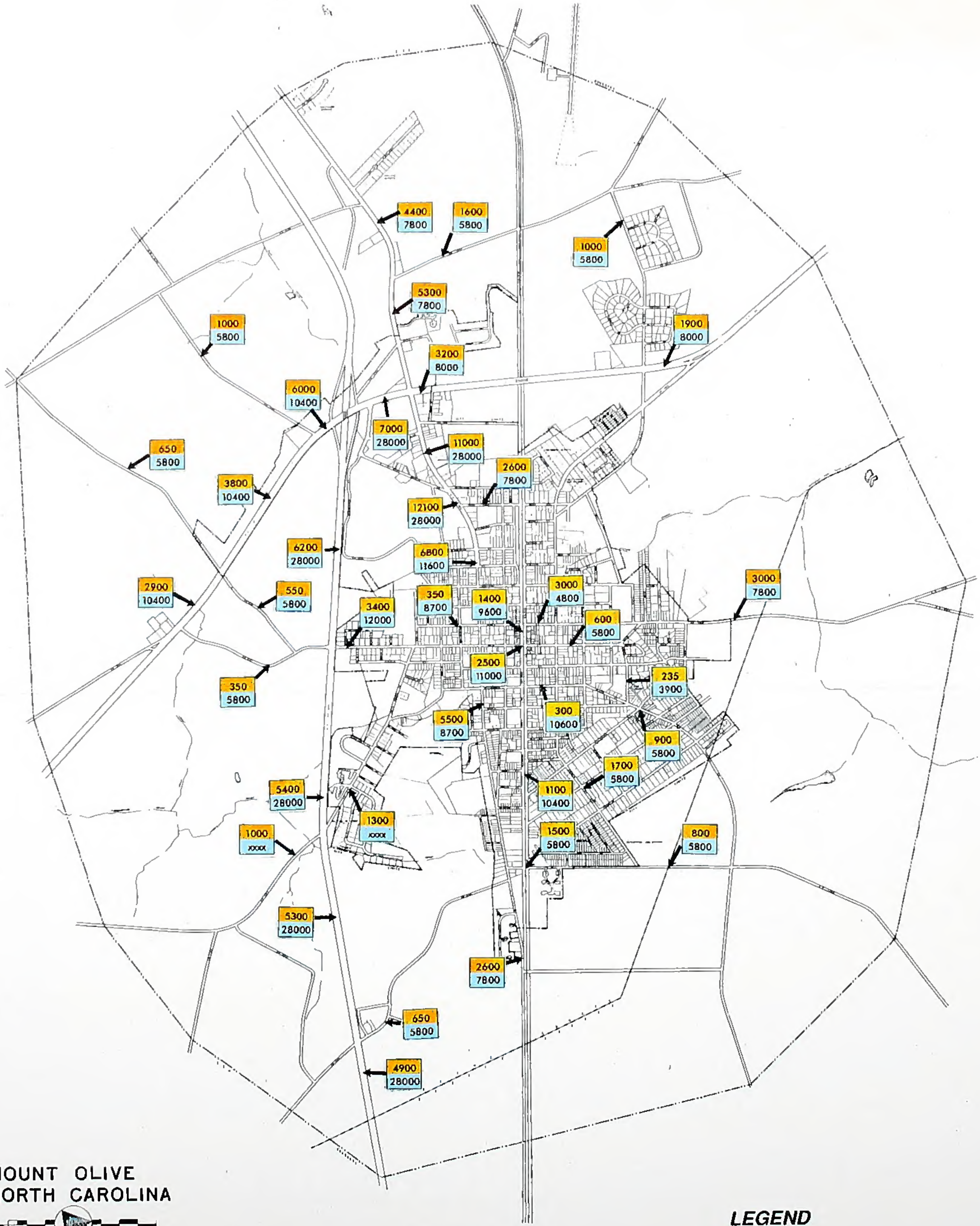
No Build Alternative

Not implementing a thoroughfare plan or elements of it could be called a No-Build Alternative. This means that there would be no new construction or roadway improvements to the Mount Olive thoroughfare system except for routine maintenance. These areas could experience capacity problems:

James Street (Between Main Street and East Planning Boundary)
Main Street (Between James Street and Church Street)
Breazeale Avenue (US 117 Alternate) (Between James and Station Streets)
US 117 Alternate (North of the three lane section to North Planning Boundary)

With these roads at or near capacity, the result will be a dramatic reduction in transportation quality. All the above routes are major entrances to the Mount Olive area. The absence of improvements will negatively impact growth and business.

Figure 5 shows the existing system if no improvements are made by the design year.



MOUNT OLIVE
NORTH CAROLINA

LEGEND

1992 — 1992 ADT
capacity — CAPACITY

FIGURE 4
BASE YEAR ADT'S COMPARED WITH CAPACITY

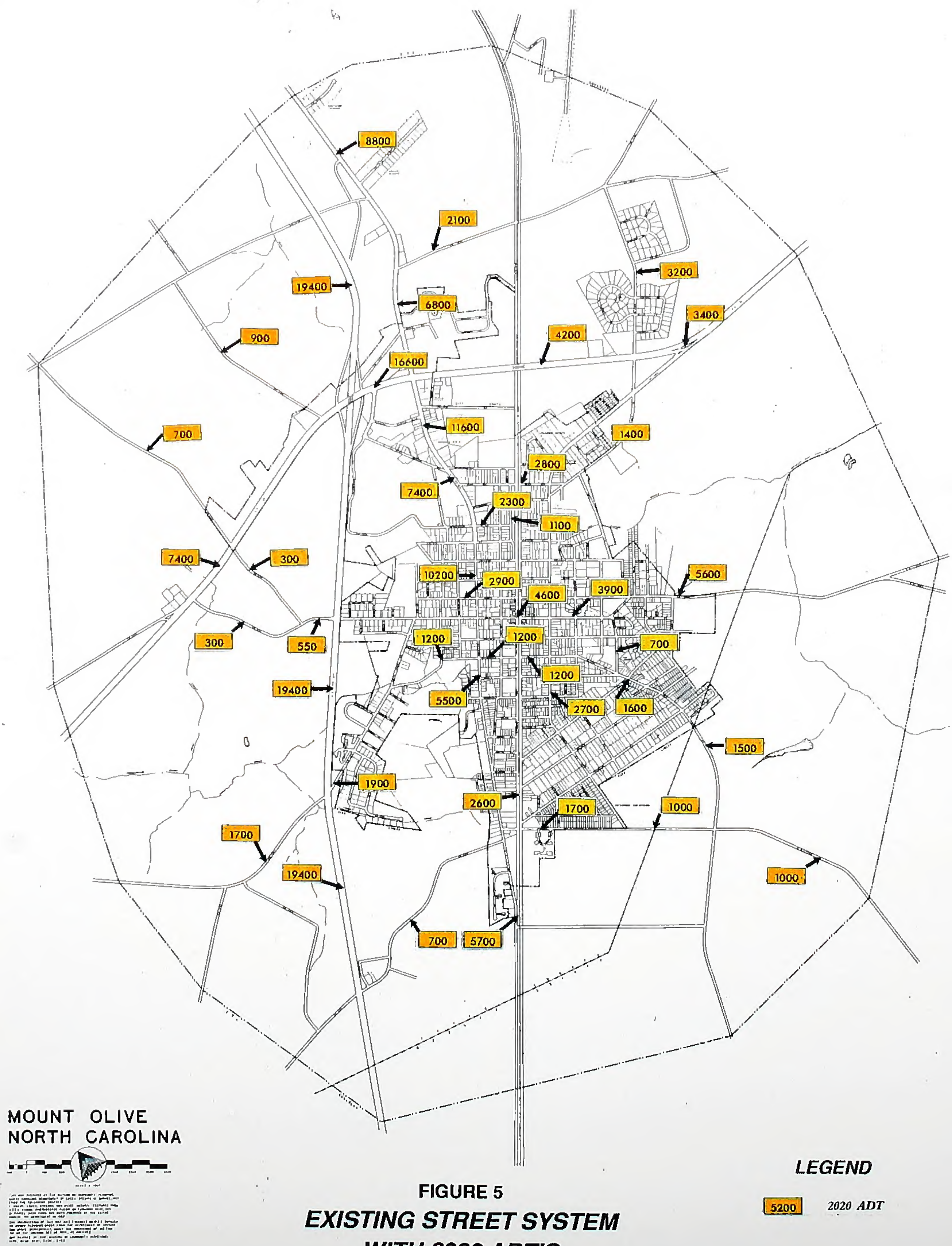


FIGURE 5
EXISTING STREET SYSTEM WITH 2020 ADT'S

Chapter 5

POPULATION, LAND USE, AND TRAFFIC

Factors Affecting Transportation

The factors of population, land use, and traffic play a vital role in determining the transportation needs of a city. Examination of these factors helps explain historic travel patterns and lays the groundwork for thoroughfare planning.

To formulate an adequate year 2020 thoroughfare plan, reliable forecasts of future travel characteristics must be achieved. The factors of population, vehicle usage trends, economy, and land use play a significant role in determining the transportation needs of the area, and must be carefully analyzed. Additional items may include the effects of legal controls such as subdivision regulations and zoning ordinances, availability of public utilities and physical features of the area.

The first step in the development of the thoroughfare plan is to define the planning period and the planning area. The planning period is typically on the order of 30 years. The base year for Mount Olive was 1992, and the year 2020 was chosen to be the endpoint of the study period (28 years). The planning area is generally the limits to which urbanization is expected to occur during the planning period. The planning area is then subdivided into traffic analysis zones. Figure 6 shows the planning area boundary and zones.

Population

Travel is directly related to population. The volume of traffic on any given section of roadway is closely related to the size and distribution of the population that it serves. Because of this relationship, one of the basic steps in planning a transportation system is an in-depth population study. Population trends for Mount Olive and Wayne County are shown in Table 7.

The most important population estimate for development of the thoroughfare plan is that of the planning area. Although the government census data is not available for the transportation planning area, other methods of estimation of population are available. The 1992 housing "windshield" survey for this study area gave a final count of 2,080 homes. The housing count was then multiplied by the average persons per dwelling unit for Wayne County (2.65) to give a total planning area population of 5,512. Population projections are shown in Table 8.

Table 7

Population Trends for the Mount Olive Planning Area

Year	Mount Olive	Wayne County	Brogden Township
1920	2,297	43,640	6,689
1930	2,685	53,013	7,453
1940	2,929	58,328	7,880
1950	3,732	64,267	8,853
1960	4,673	82,059	10,250
1970	4,914	85,408	13,442
1980	4,876	97,054	18,005
1990	4,582	104,666	18,691
2000	5,061[2]	111,456[1]	20,646[2]
2010	5,590[2]	114,080[1]	22,807[2]
2020	6,176[2]	115,748[1]	25,193[2]

[1]Projections from U.S. Census - Office of State Budget and Management
[2]Projections from the Office of State Planning

Table 8

Population Projections for the Mount Olive Planning Area

Year	Planning Area
1992	5,512
2000	5,969
2010	6,593
2020	7,283

Economy and Employment

One of the more important factors to be considered in estimating the future traffic growth of an area is its economic base. The number of employers and the employee's income or purchasing power influences how much population can be supported in the area and the number of motor vehicles that will be locally owned and operated. Generally, as the family income increases so does the number of vehicles owned, as well as the number of vehicles trips generated per day by each household. An accurate projection of the future economy of the area is essential to estimating future travel demand.

Obviously the socioeconomic health of Mount Olive is dependant upon industries such as the Mount Olive Pickle

Company, Boling Chair Company, and Burlington Industries. These are the major employers in the planning area.

Land Use

Land use refers to the physical patterns of activities and functions within the city. Nearly all traffic problems in a specific area are relative to the area's land use. The amount of traffic on a particular street is very closely related to its adjacent land use. For example, a large industrial plant might be the cause of congestion during shift change hours as its workers come and go. However, during the remainder of the day little, if any, problems might occur. The spatial distribution of different types of land use (sometimes referred to as traffic generators) is the predominant determinant of when, where, and why congestion occurs. The attraction between different land uses and their association with travel varies depending on the size, type, intensity, and spatial separation of each.

For use in transportation planning, land uses are grouped into four categories: (1) Residential - all land devoted to the housing of people except hotels and motels; (2) Commercial - all land devoted to retail trade including consumer and business services and offices; (3) Industrial - all land devoted to manufacturing, storage, warehousing, and transportation of products; and (4) Public - all land devoted to social, religious, educational, cultural, and political activities. Figure 7 shows the planning area's existing land use.

Anticipated future land use is a logical extension of the present spatial distribution. Determination of where expected growth is to occur within the planning area facilitates the location of proposed thoroughfares. Areas of anticipated development and growth for Mount Olive are:

> Residential - A large amount of Mount Olive's residential land development is located on the northern and western side of the planning area.
>
> Commercial/Retail - Most of the commercial development, in Mount Olive is expected to be located north of town near US 117 Alternate. The CBD in the center of town is not expected to significantly grow.
>
> Industrial - No significant industrial development is expected in the planning area. However, there is a planned expansion of the Mount Olive Pickle Company.
>
> Public - The only significant public land use change expected is the relocation of Carver Elementary School to the northeast corner of town near Seven Springs Road.

The Mount Olive College near the center of town is expected to significantly increase enrollment. There are no parks or other entertainment areas planned in the near future.

The western and northern portions of the planning area have the largest growth expectations and are served by two major routes - US 117 Bypass and NC 55. The southern and eastern portions of the planning area are not served by a major route. Hopefully, the implementation of the thoroughfare plan and the Mount Olive Outer Loop will help encourage development on the other portions of the area, especially in the east.

Areas in the southeast and southern part of the planning area have little residental growth potential due to the soil. The soil will not perk for a septic tank.

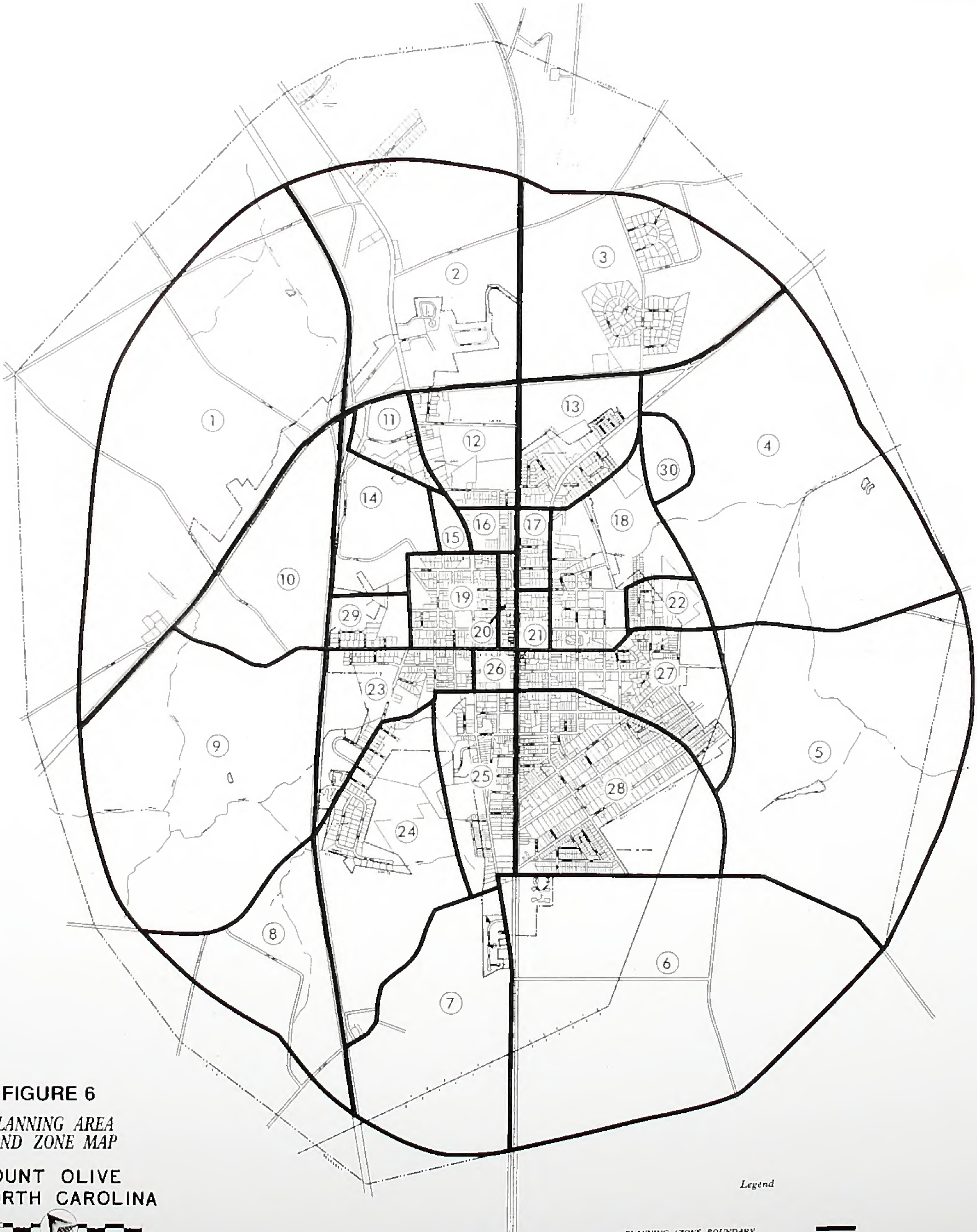


FIGURE 6

PLANNING AREA AND ZONE MAP

MOUNT OLIVE
NORTH CAROLINA

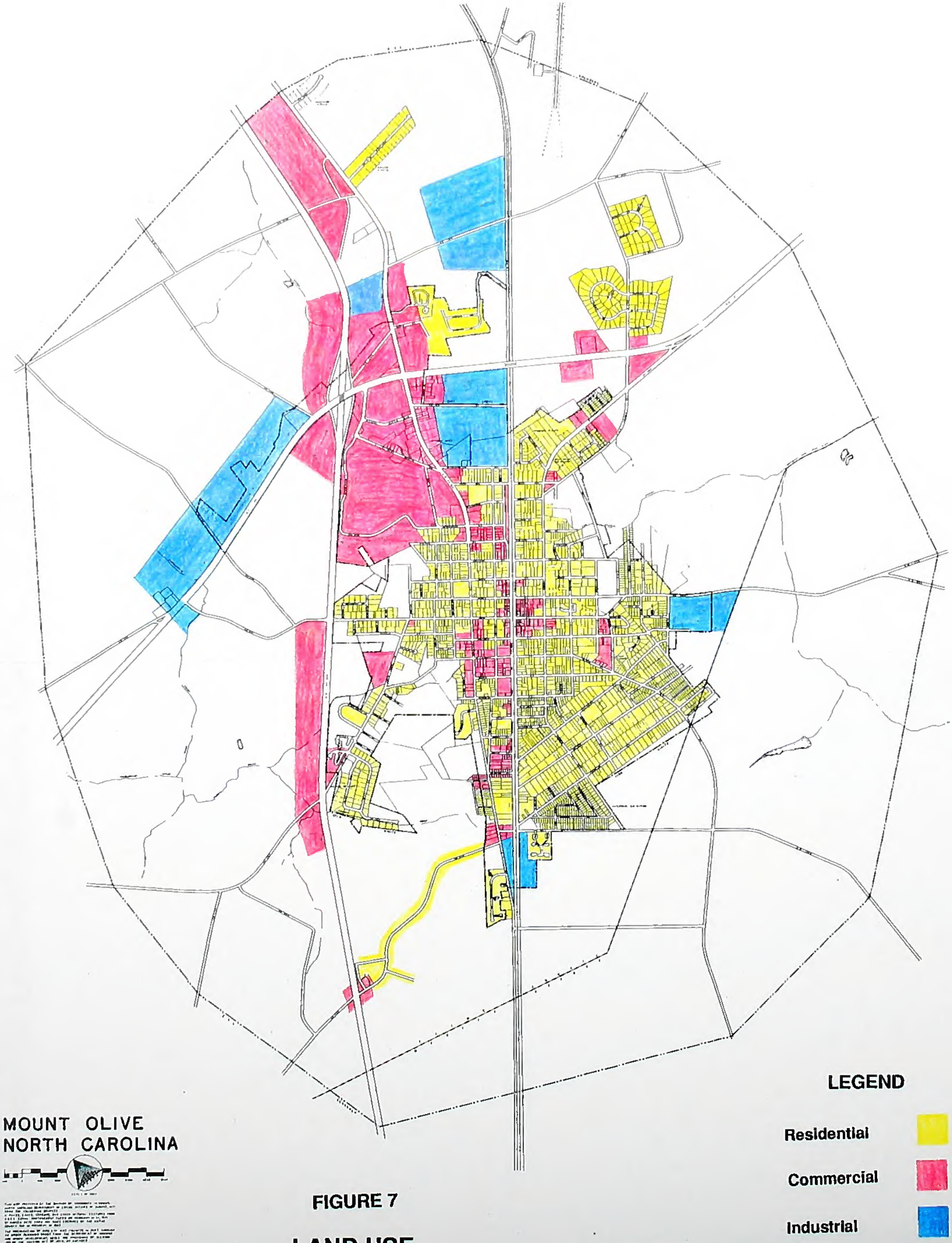


FIGURE 7

LAND USE

Chapter 6

ENVIRONMENTAL CONCERNS

In the past several years, environmental considerations associated with highway construction have come to the forefront of the planning process. The legislation that dictates the necessary procedures regarding environmental impacts is the National Environmental Policy Act. Section 102 of this act requires the execution of an Environmental Impact Statement, or EIS, for road projects that have a significant impact on the environment. Included in an EIS would be the project's impact on wetlands, water quality, historic properties, wildlife, and public lands. While this report does not cover the environmental concerns in as much detail as an EIS would, preliminary research was done on several of these factors and is included below.

Wetlands

In general terms, wetlands are lands where saturation with water is the dominant factor in determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. The single feature that most wetlands share is soil or substrate that is at least periodically saturated with or covered by water. Water creates severe physiological problems for all plants and animals except those that are adapted for life in it or in saturated soil.

Wetlands are crucial ecosystems in our environment. They help regulate and maintain the hydrology of our rivers, lakes, and streams by slowly storing and releasing flood waters. They help maintain the quality of our water by storing nutrients, reducing sediment loads, and reducing erosion. They are also critical to fish and wildlife populations. Wetlands provide an important habitat for about one third of the plant and animal species that are federally listed as threatened or endangered.

In this study, the impacts to wetlands were determined using the National Wetlands Inventory Mapping, available from the U.S. Fish and Wildlife Service. The location of wetlands in the Mount Olive Planning Area is shown in Figure 8.

Wetlands impacts have been avoided or minimized to the greatest extent possible while preserving the integrity of the transportation plan. No wetland impacts are expected with the Mount Olive Thoroughfare Plan.

MOUNT OLIVE
NORTH CAROLINA

LEGEND

SIGNIFICANT WETLANDS

FIGURE 8

WETLAND AREAS

Threatened and Endangered Species

A preliminary review of the Federally Listed Threatened and Endangered Species within the Mount Olive Planning Area was done to determine the effects that new corridors could have on the wildlife. These species were identified using mapping from the North Carolina Department of Environment, Health, and Natural Resources.

The Threatened and Endangered Species Act of 1973 allows the U. S. Fish and Wildlife Service to impose measures on the Department of Transportation to mitigate the environmental impacts of a road project on endangered plant and animals and critical wildlife habitats. By locating rare species in the planning stage of road construction, we can avoid or minimize these impacts.

There are no federally listed threatened or endangered species in the Mount Olive Planning Area. Detailed field investigation is recommended prior to construction of any highway project in this area.

Historic Sites

The location of historic sites in Mount Olive was investigated to determine the possible impacts of the various projects studied. The federal government has issued guidelines requiring all State Transportation Departments to make special efforts to preserve historic sites. In addition, the State of North Carolina has issued its own guidelines for the preservation of historic sites. These two pieces of legislation are described below:

> National Historic Preservation Act - Section 106 of this act requires the Department of Transportation to identify historic properties listed in the National Register of Historic Places and properties eligible to be listed. The DOT must consider the impact of its road projects on these properties and consult with Federal Advisory Council on Historic Preservation.
>
> NC General Statue 121-12(a) - This statue requires the DOT to identify historic properties listed on the National Register, but not necessarily those eligible to be listed. DOT must consider impacts and consult with the North Carolina Historical Commission, but it is not bound by their recommendations.

There are currently twenty properties in the Mount Olive Planning Area that are listed on the National Register of Historic Places. None of these properties should be affected by the projects proposed on the thoroughfare plan. The proposed widening of Breazeale Avenue is through the historic

district of Mount Olive. Although no homes listed on the historic register front Breazeale Avenue, special care should be taken on this project. One historic home is located near the intersection of Main Street and US 117 Bypass. If the plans to upgrade US 117 to an access controlled facility with an interchange at Main Street are implemented, the interchange may need to be shifted to avoid this historic home.

Care should be taken to make certain that all historic sites and natural settings are preserved. Therefore, a closer study should be done of the local historic sites prior to the construction of any proposal.

Chapter 7

TRAFFIC MODEL DEVELOPMENT

In order to develop an efficient thoroughfare plan for Mount Olive it was necessary to develop and calibrate a traffic model of the Town. To develop a traffic model the following things are necessary: define the study area, collect traffic counts and socioeconomic data, determine the trip generation characteristics of the study area, calibrate the traffic model so that it duplicates patterns of the study area, and project the socioeconomic data to the design year. Once the socioeconomic data has been projected the model may be used to evaluate various street system problems and alternate solutions to the problems.

The Study Area

The study area for Mount Olive consists the Town and some additional outlaying area (Figure 6). This area was divided into 30 zones for data collection and aggregation. These zones reflect similar land use throughout the planning area. The data for the dwelling units and employment for 1992 was collected from census data and windshield surveys. The projections of socioeconomic data to the future year was done based on past trends from previous census data and projections by the Office of State Planning.

The Base Year Network

The purpose of the traffic model is to replicate the conditions on the Town street system. Therefore it is necessary to represent the existing street system in the model. There is a balance between having too many streets on the model to allow it to be calibrated and not having enough streets to realistically duplicate existing conditions. Generally, all the major arterials and some of the major land access or collector streets need to be represented.

Street capacity is an important component of the model. The volume/capacity ratio (v/c) gives us our best indication of present and future traffic congestion.

Speed and distance are the major factors that define the minimum time paths from zone to zone. The model uses the minimum time paths as the basis for assigning traffic to streets. Generally in the Mount Olive model the speeds assigned to links of the street system are at or slightly below the posted speed limit. Common speeds used are 20, 35, 40, and 50 miles per hour. Figure 9 shows the Tranplan Network overlayed on the actual street system.

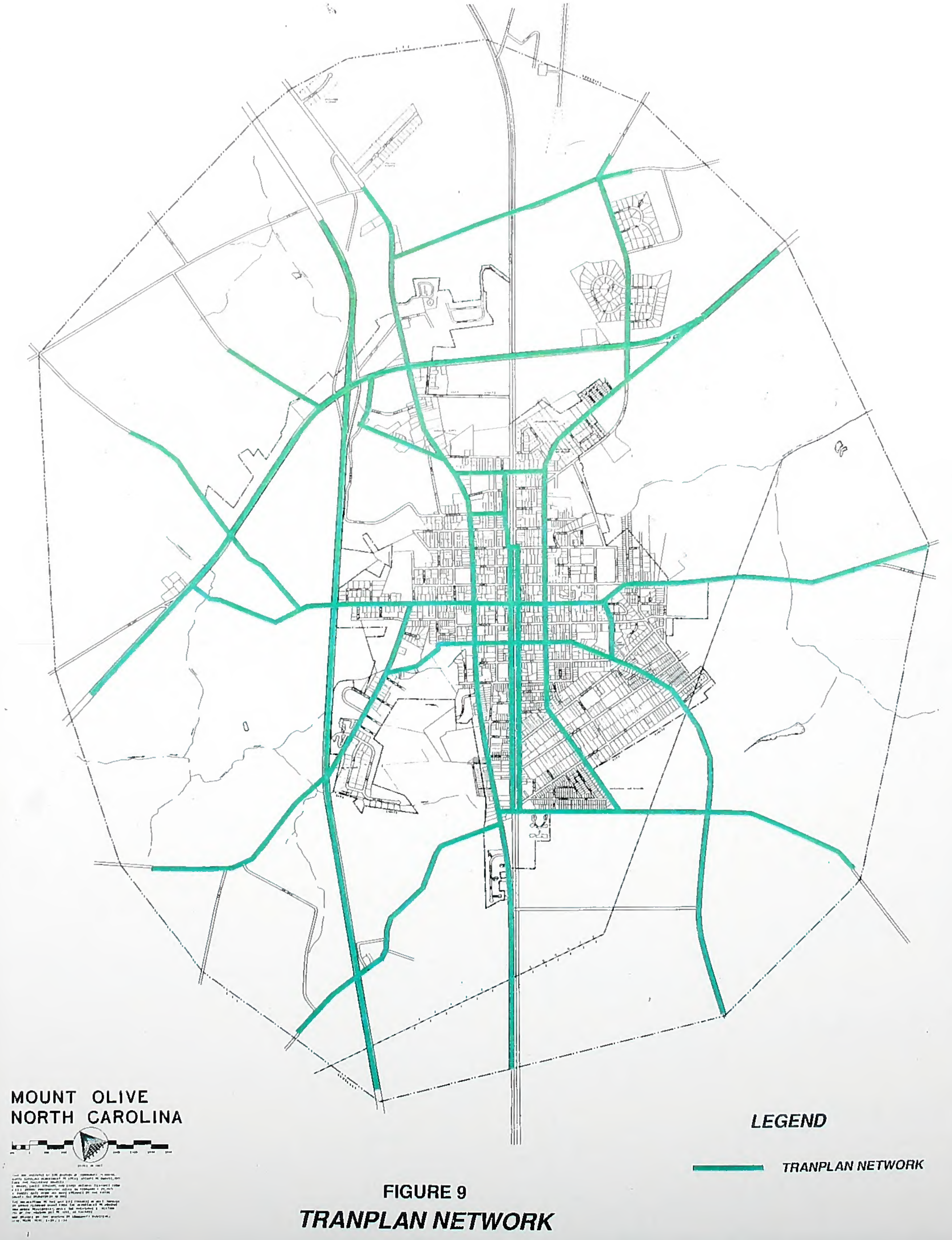


FIGURE 9
TRANPLAN NETWORK

Data Requirements

In order to produce an adequate traffic model of the study area, two additional types of data are required. First, traffic counts on routes used in the model provide a basis for calibrating the model. These traffic counts show a snapshot of traffic conditions in the study area. Second, socioeconomic data (housing counts and employment estimates) are necessary in order to generate traffic for the model. The housing and socioeconomic data for the model are shown in Figures 11 and 12.

Traffic Counts - The model must be calibrated against existing conditions in the study area. In order to calibrate the model traffic counts must be taken at various locations around the study area. The counts for much of the Mount Olive study were collected during January, 1993. Most of the city streets which had no count data available from Average Daily Traffic Count Maps were collected in November, 1993. Traffic Count locations are found in Figure 10.

Also, volumes on all routes crossing the planning area boundary were counted. These counts show how much traffic is entering and exiting the study area.

Socioeconomic Data - The required data consists of a housing counts and employment estimates. The housing counts are used in the model as the generator of trips and employment is used as the attractor of trips.

The best indicator of the average number of trips made from a household in a day is the household income. Since there is no adequate method for determining household income, the type and quality of housing was used as an indicator of household income. The Statewide Planning staff conducted a windshield survey in May, 1993 to collect housing and employment data. The housing inventory was divided into five categories: excellent, above average, average, below average, and poor. Each of these categories was assigned a slightly different trip generation rate. Figure 12 shows the housing counts for each traffic zone.

The employment data that was collected was broken out by Standard Industrial Code classification and grouped into five categories: Industry, Special Retail, Retail, Office and Services. The number of employees of each business was estimated. This data was used with a regression equation developed from an origin and destination survey of a similar size Town to produce an attraction factor for each zone. Figure 11 shows total employment by traffic analysis zone.

Commercial Vehicles

Commercial vehicles have somewhat different trip generation characteristics than do privately owned vehicles. For the purposes of this model, and the little impact they were expected to have, commercial vehicle data was not collected.

Trip Generation

The trip generation process is the process by which external station volumes, housing data, and employment data are used to generate traffic volumes that duplicate the traffic volumes on the street network. The technical definition of a trip is slightly different then the definition of a trip used by the general public. Technically a trip only has one origin and one destination while the layman will often group, or chain, several short trips together as one longer trip.

Traffic inside the study area has three major components through trips, internal-external trips, and internal trips. Through trips are produced outside the planning area and pass through enroute to a destination outside the planning area. Internal-external trips have one end of the trip outside of the planning area. Internal trips have both their origin and destination inside the planning area. For clarity the internal trips are further subdivided into trip purposes. The trip purposes for Mount Olive are home-based work, other-home based, and non-home based.

Through Trips - The Through Trip Table for this study was developed based on Technical Report Number 3 (Synthesized Through Trip Table for Small Urban Areas by Dr. David G. Modlin, Jr.).

Once these volumes were developed the fratar balancing method was then used to balance the trip interchanges so that the total number of through trips at each external station is consistent with the total number of through trips at every other station. Generally five iterations are sufficient to balance the error between external zones.

External - Internal trip volume was determined by subtracting the through trip volume at each station from the total traffic volume at that station. See Table 11 for external - internal and through trip values.

Internal Data Summary - (IDS) is the process that takes the external - internal traffic volumes, housing data, employment data, generation rates, and regression equations and generates the trip productions and trip attractions required by the gravity model. Housing units were stratified to account for differing trip

generation rates for each classification. The individual trip generation rates give an average trip generation rate for the study area of 7.27 trips per dwelling unit (du) for 1992 and 7.46 for 2020 (estimate). This within the state average of 7 to 8 trips per dwelling unit. Trip attractions were produced using regression equations. The regression equations considers trip attractions to be related to the employment characteristics of the traffic zones. The regression equations for Mount Olive are:

OHB $Y= .10X_1 + 2.0X_2 + 8.4X_3 + 2.6X_4 + 2.5X_5$
NHB $Y= .20X_1 + 2.0X_2 + 8.4X_3 + 2.6X_4 + 2.5X_5$
EXT $Y= .50X_1 + 2.0X_2 + 8.4X_3 + 2.6X_4 + 2.5X_5$

WHERE: Y = Attraction factor for each zone
X1 = Industry (SIC codes 1-49)
X2 = Retail (SIC codes 55,58)
X3 = Special Retail (SIC codes 50-54,56,57,59)
X4 = Office (SIC codes 60-67, 91-97)
X5 = Services (SIC codes 70-76, 78-89, 99)

The output of the IDS program are trip productions and trip attractions for each zone divided into four trip purposes: home-based work, non-home based and external-internal. The trips are segregated into trip purposes because different trip lengths are associated with each trip purpose.

Internal Trip Distribution

Once the number of trips per traffic zone are determined, the trips must still be distributed to other traffic zones. The preferred method of distributing internal and external-internal trips, called the 'Gravity Model', states that the number of trips between Zone A and Zone B is proportional to the number of trips produced in Zone A multiplied by the number of trips attracted to Zone B multiplied by a travel time factor. The gravity model takes the form:

$$T_{ij} = \frac{P_i \times A_j \times F_{ij}}{\text{Sum } x=1,n \text{ of } A_x F_{i,x}}$$

T_{ij} = The number of trips produced in zone i and attracted to zone j.
P_i = The number of trips produced in zone i.
A_j = The number of trips attracted to zone j.
F_{ij} = The travel time factor.
n = The total number of zones.
i = The origin zone number.
j = The destination zone number.
x = Any zone number.

The travel time factor or friction factor (F) is critical to the gravity model distribution and must be derived empirically. The friction factor is dependent on the distance between the traffic zones and the time necessary to travel these distances. This factor is also dependent on the trip purpose. In order to derive this factor a gravity model calibration program is run with an initial friction factor and trip length frequency curve for each trip purpose. The initial friction factors used in the Mount Olive model were 100 for all trip purposes and time increments. Table 12 shows the actual values used for the friction factors and trip length frequency curves.

Model Calibration

The purpose of a traffic model is to predict the traffic on a street system at some future point in time; however, if the model is not accurate, it is useless for this purpose. Therefore the model must duplicate the existing traffic pattern. The actual calibration of the model is an iterative process in which incremental changes are made either in the trip generation, trip distribution, or the street network. The purpose of each change is to allow the model to more accurately reflect the real world conditions upon which it is based. Only when the model can adequately reflect the existing traffic pattern should it be used to predict traffic in the future. The model was calibrated with 1992 Average Daily Traffic Counts on all routes that it was available. On roadways without counts, data was collected in November 1993, and used for screenline checks. Since there was no significant increase in traffic on most routes from the 1992 counts to 1993, the one year difference on some of the data collected was negigible.

Accuracy Checks

There are three checks made on the model. The first is to follow trips through all the steps involved in the model. The purpose of this check is to insure that no trips have been accidentally added to or subtracted from the model, and that no trips have been counted twice.

The second check is to compare the model generated trips on the screenlines with the ground counts taken at the screenlines. A model is considered to accurately reflect the overall patterns if the trips it generates are from 95% to 105% of the ground counts on the screenlines. Table 9 compares the ground counts with the model traffic volumes on the screenlines. See Figure 9 for screenline location.

The final check for the model is to match the traffic volumes on the links in the model with the ADT at the same location.

The 'link counts' can be used to find particular places in the network where there are problems. Comparing the link counts with the ground counts for those links did not reveal any significant problems with the model.

Table 9

Actual vs. Modeled Screenline Totals

Screenline	Ground Count	Model Volume	Percent
A NS	16700	15920	95%
B EW	25700	25924	101%

Data Projections to the Design Year

In order to make use of the model the base year data must be modified to reflect assumed conditions in the design year. These projections and the previously developed regression equations were used to produce trip productions and attractions in the same manner as the base year.

Employment Projections - The Mount Olive Planning Board projected the employment to 2020 from the zones they anticipated employment growth. Those projections were added to the 1992 data. Employment projections throughout the planning area indicates slow, but steady, growth. Figure 11 compares the classification of employment data in 1992 with the assumed classification in 2020.

Dwelling Unit Projections - Future dwelling units were determined by extending person per dwelling unit trends for Wayne county linearly to the design year. The number of dwelling units are projected to increase by 8%. The Mount Olive Planning Board projected residential growth and the Statewide Planning Unit distributed these houses throughout the planning area. Figure 12 compares the classification of dwelling units in 1992 with the assumed classification in 2020.

External and Through Trips - For the design year, external and through trips were projected from the base year using a linear projection of the past growth rate at each external station. Cordon Station Data can be found in Table 13.

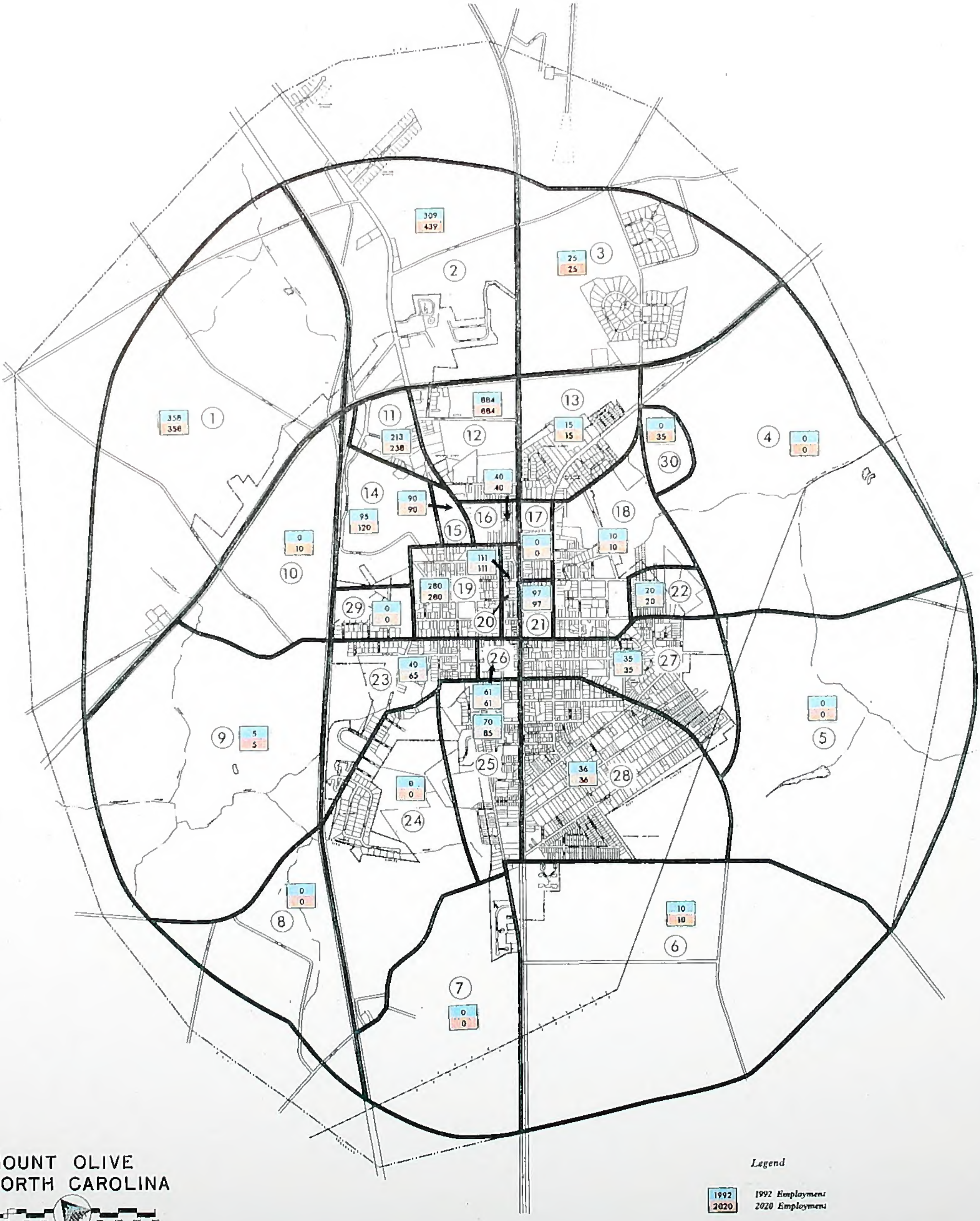
Peculiarities of the Mount Olive Model

There was one location of the model that was difficult to calibrate. This was the section of NC 55 between US 117 Bypass and US 117 Business (Breazeale Avenue). This model made many trips go between these two roads on NC 55, therefore making the model volume on this route much higher than the actual ground count. This section is a five lane section and even with the higher volumes, would not experience any capacity problems.

The Mount Olive Outer Loop was placed on the future year network to discover deficiencies in the existing system and the effect on the future traffic if built. The Outer Loop seemed to attract much of the traffic from the interior of Town, especially through traffic.

FIGURE 10

TRAFFIC COUNT LOCATIONS



MOUNT OLIVE
NORTH CAROLINA

FIGURE 11
EMPLOYMENT BY ZONE

MOUNT OLIVE
NORTH CAROLINA

FIGURE 12

HOUSING TOTALS BY ZONE

Table 12			
Travel Model Input Variables			
TRIP PERCENTAGES BY PURPOSE	YEAR	PERSON/DU	PERSONS/VEH
Internal of Total 85%			
HBW 25%	1992	2.65	1.53
OHB 53%			
NHB 22%	2020	2.43	1.38

$$\text{COMPOSITE FACTOR} = \frac{\text{1990 PERSON/VEH}}{\text{2020 PERSON/VEH}} \times \text{USAGE FACTOR} \times \frac{\text{2020 PERSON/DU}}{\text{1990 PERSON/DU}}$$

$$\text{INCREASE FOR DESIGN YEAR GENERATION RATES} = \text{AVERAGE 1992 TRIP RATE} \times \text{COMPOSITE FACTOR} - \text{AVERAGE 1992 TRIP RATE}$$

$$\text{COMPOSITE FACTOR} = \frac{1.53}{1.38} \times 0.98 \times \frac{2.43}{2.65} = .996$$

Use 1.00

INCREASE FOR 2020 GENERATION RATES = 0 (7.5 x 1)-7.5=0

Since the increase is zero, all design year generation rates are the same as the base year generation rates.

Secondary NHB Trip Development

Secondary NHB Trips = Total Ext-Int Trips - Ext-Int Trips Garaged Inside Planning Area x 0.40*

1992 Secondary Trips = (21,723 - 2,133) X 0.4 = 7,836

2020 Secondary Trips = (34,598 - 2,968) X 0.4 = 12,652

The breakdown of internal trips by purpose and total of non-home based trips generated externally are shown in Table 10.

* Assumed NHB trip making rate per each one-way external -internal trip by vehicles garaged outside the planning area.

Table 11		
Travel Data Summary		
TYPE	1992	2020
Average Daily Trips per DU	7.27	7.46
Internal Trips	12,092	16,818
Home Based Work	3,023	4,205
Other Home Based	6,409	8,914
Non-Home Based, internal	2,660	3,700
NHB secondary	7,836	12,652
Internal <-> External	21,723	34,598
Through Trips	10,127	25,776
TOTAL DAILY TRIPS	43,942	77,192

Table 12

Friction Factors & Travel Curve Data
Mount Olive

	FRICTION FACTORS				TRAVEL CURVES			
TIME					% TRIPS DISTRIBUTED			
INTERVAL	HBW	OHB	NHB	EXT-INT	HBW	OHB	NHB	EXT-INT
1	23208	14820	6177	41366	4.99	5.38	5.00	0.00
2	209714	146876	30208	60952	15.05	11.58	8.70	0.20
3	318242	245751	39615	45775	20.34	17.20	19.20	21.14
4	133377	114391	20009	21423	22.88	23.39	33.41	30.84
5	25588	24409	5591	7638	19.28	27.71	28.00	25.81
6	3724	3935	1241	2537	9.39	9.12	3.80	19.46
7	682	789	314	959	5.49	4.29	1.30	2.00
8	260	325	131	505	2.18	1.54	0.50	0.50
9	343	452	128	453	0.40	0.30	0.00	0.00

Table 13

Cordon Station Travel

COMPUTER STATION	BASE YEAR - 1992 Total ADT	Thru Trip End	Ext-Int Trips	FUTURE YEAR 2020 Total ADT	Thru Trip End	Ext-Int Trips
51	7,500	3,363	4,137	15,000	9,569	5,432
52	4,400	1,618	2,782	8,800	4,195	4,605
53	1,600	235	1,365	2,432	397	2,035
54	1,900	463	1,437	3,800	1,093	2,708
55	2,800	540	2,260	5,600	1,458	4,142
56	650	89	561	988	139	849
57	300	38	262	456	58	398
58	2,600	835	1,765	5,200	1,992	3,208
59	4,900	1,866	3,034	9,800	4,926	4,874
60	300	34	266	456	51	405
61	950	138	812	1,444	199	1,245
62	2,900	782	2,118	4,800	1,505	3,295
63	450	53	397	684	81	603
64	600	73	527	912	113	799

Chapter 8

THOROUGHFARE PLANNING PRINCIPLES

There are many advantages to thoroughfare planning, but the primary mission is to assure that the road system will be progressively developed to serve future travel desires. Thus, the main consideration in thoroughfare planning is to make provisions for street and highway improvements so that, when the need arises, feasible opportunities to make improvements exist.

Benefits of Thoroughfare Planning

There are two major benefits derived from thoroughfare planning. First, each road or highway can be designed to perform a specific function and provide a specific level of service. This permits savings in right-of-way, construction, and maintenance costs. It also protects residential neighborhoods and encourages stability in travel and land use patterns. Second, local officials are informed of future improvements and can incorporate them into planning and policy decisions. This will permit developers to design subdivisions in a non-conflicting manner, direct school and park officials to better locate their facilities, and minimize the damage to property values and community appearance that is sometimes associated with roadway improvements.

Thoroughfare Classification Systems

Streets perform two primary functions, traffic service and land access, which when combined, are basically incompatible. The conflict is not serious if both traffic and land service demands are low. However, when traffic volumes are high, conflicts created by uncontrolled and intensely developed abutting property lead to intolerable traffic flow friction and congestion.

The underlying concept of the thoroughfare plan is that it provides a functional system of streets that permits travel from origins to destinations with directness, ease and safety. Different streets in this system are designed and called on to perform specific functions, thus minimizing the traffic and land service conflict.

Urban Classification

In the urban thoroughfare plan, elements are classified as major thoroughfares, minor thoroughfares, or local access streets.

Major Thoroughfares are the primary traffic arteries of the urban area providing for traffic

movements within, around, and through the area.

Minor Thoroughfares are designed to collect traffic from the local access streets and carry it to the major thoroughfare system. Local Access Streets provide access to abutting property. Local streets may be further classified as either residential, commercial and/or industrial depending upon the type of land use that they serve.

Idealized Major Thoroughfare System

The coordinated system of major thoroughfares that is most adaptable to the desired lines of travel within an urban area and that is reflected in most urban area thoroughfare plans is the radial-loop system. The radial-loop system includes radials, crosstowns, loops, and bypasses (Figure 13).

Radial streets provide for traffic movement between points located on the outskirts of the city and the central area. This is a major traffic movement in most cities, and the economic strength of the central business district depends upon the adequacy of this type of thoroughfare.

If all radial streets crossed in the central area, an intolerable congestion problem would result. To avoid this problem, it is very important to have a system of crosstown streets that form a loop around the central business district. This system allows traffic moving from origins on one side of the central area to destinations on the other side to follow the area's border. It also allows central area traffic to circle and then enter the area near a given destination. The effect of a good crosstown system is to free the central area of crosstown traffic, thus permitting the central area to function more adequately in its role as a business or pedestrian shopping area.

Loop system streets move traffic between suburban areas of the city. Although a loop may completely encircle the city, a typical trip may be from an origin near a radial thoroughfare to a destination near another radial thoroughfare. Loop streets do not necessarily carry heavy volumes of traffic, but they function to help relieve central areas. There may be one or more loops, depending on the size of the urban area. They are generally spaced one-half mile to one mile apart, depending on the intensity of land use.

A bypass is designed to carry traffic through or around the urban area, thus providing relief to the city street system by removing traffic that has no desire to be in the city. Bypasses are usually designed to through-highway standards, with control of access. Occasionally, a bypass with low traffic volume can be designed to function as a portion of an urban loop. The general effect of bypasses is to expedite the movement of through traffic and to improve traffic conditions within the city. By freeing the local streets for

use by shopping and home-to-work traffic, bypasses tend to increase the economic vitality of the local area.

Objectives of Thoroughfare Planning

Thoroughfare planning is the process public officials use to assure the development of the most appropriate street system to meet the existing and future travel desires within the urban area.

The primary aim of a thoroughfare plan is to guide the development of the street system in a manner consistent with changing traffic demands. Through proper planning for street development, costly errors and needless expense can be averted. A thoroughfare plan will enable street improvements to be made as traffic demands increase, and help eliminate unnecessary improvements. By developing the street system to keep pace with increasing traffic demands, a maximum utilization of the system can be attained that will require a minimum amount of land for street purposes. In addition to providing for traffic needs, the thoroughfare plan should embody those details of good urban planning necessary to present a pleasing and efficient urban community. The location of present and future population, commercial and industrial enterprises, affects major street and highway locations. Conversely, the location of major streets and highways within the urban area will influence the urban development pattern.

Other objectives of a thoroughfare plan include:

- To provide for the development of an adequate major street system as land development occurs;
- To reduce travel and transportation costs;
- To reduce the cost of major street improvements to the public through the coordination of street system with private action;
- To enable private interests to plan their actions, improvements, and development with full knowledge of public intent;
- To minimize disruption and displacement of people and businesses through long range planning for major street improvements;
- To reduce environmental impacts such as air pollution, resulting from transportation; and
- To increase travel safety.

These objectives are achieved through improving both the operational efficiency of thoroughfares, and improving the system efficiency by system coordination and layout.

Operational Efficiency

A street's operational efficiency is improved by increasing the capability of the street to carry vehicular traffic and people. In terms of vehicular traffic, a street's capacity is the maximum number of vehicles that can pass a given point on a roadway during a given period under prevailing roadway and traffic conditions. Capacity is affected by the physical features of the roadway, nature of traffic, and weather.

Physical ways to improve vehicular capacity include:

Street widening - widening a street from two to four travel lanes more than doubles the capacity by providing additional maneuverability for traffic.

Intersection improvements - increasing the turning radii, adding exclusive turn lanes, and channelizing movements can improve the capacity of an existing intersection.

Improving vertical and horizontal alignment - reduces the congestion caused by slow moving vehicles.

Eliminating roadside obstacles - reduces side friction and improves a driver's field of sight.

Operational ways to improve street capacity include:

Control of access - A roadway with complete access control can often carry three times the traffic handled by a non-controlled access street with identical lane width and number.

Parking removal - Increases capacity by providing additional street width for traffic flow and reducing friction to flow caused by parking and unparking vehicles.

One-way operation - The capacity of a street can sometimes be increased 20-50%, depending upon turning movements and street width, by initiating one-way traffic operations. One-way streets also can improve traffic flow by decreasing potential traffic conflicts and simplifying traffic signal coordination.

Reversible Lanes - Reversible traffic lanes may be used to increase street capacity in situations where heavy directional flows occur during peak periods.

Signal phasing and coordination - Uncoordinated signals and poor signal phasing restrict traffic flow by creating excessive stop-and-go operation.

Altering travel demand is a third way to improve the efficiency of existing streets. Travel demand can be reduced or altered in the following ways:

<u>Carpools</u> - Encourage people to form carpools and vanpools for journeys to work and other trip purposes. This reduces the number of vehicles on the roadway and raises the people carrying capability of the street system.

<u>Alternate mode</u> - Encourage the use of alternate modes of travel such as transit and bicycles.

<u>Work hours</u> - Encourage industries, business, and institutions to stagger work hours or establish variable work hours for employees. This will reduce travel demand in peak periods and spread peak travel over a longer period.

<u>Land use</u> - Plan and encourage land use development or redevelopment in a more travel efficient manner.

System Efficiency

Another means of altering travel demand is the development of a more efficient system of streets that will better serve travel desires. A more efficient system can reduce travel distances, time, and cost. Improvements in system efficiency can be achieved through the concept of functional classification of streets and development of a coordinated major street system.

Application of Thoroughfare Planning Principles

The concepts presented in the discussion of operational efficiency, system efficiency, functional classification, and idealized major thoroughfare system are the conceptual tools available to the transportation planner in developing a thoroughfare plan. In actual practice, thoroughfare planning is done for established urban areas and is constrained by existing land use and street patterns, existing public attitudes and goals, and current expectations of future land use. Compromises must be made because of these and the many other factors that affect major street locations.

Throughout the thoroughfare planning process it is necessary from a practical viewpoint that certain basic principles be followed as closely as possible. These principles are as follows:

1. The plan should be derived from a thorough knowledge of today's travel - its component parts, and the factors that contribute to it, limit it, and modify it.

2. Traffic demands must be sufficient to warrant the designation and development of each major street. The thoroughfare plan should be designed to accommodate a large portion of major traffic movements on a few streets.

3. The plan should conform to and provide for the land development plan of the area.

4. Certain considerations must be given to urban development beyond the current planning period. Particularly in outlying or sparsely developed areas that have development potential, it is necessary to designate thoroughfares on a long-range planning basis to protect rights of way for future thoroughfare development.

5. While being consistent with the above principles and realistic in terms of travel trends, the plan must be economically feasible.

IDEALIZED THOROUGHFARE PLAN

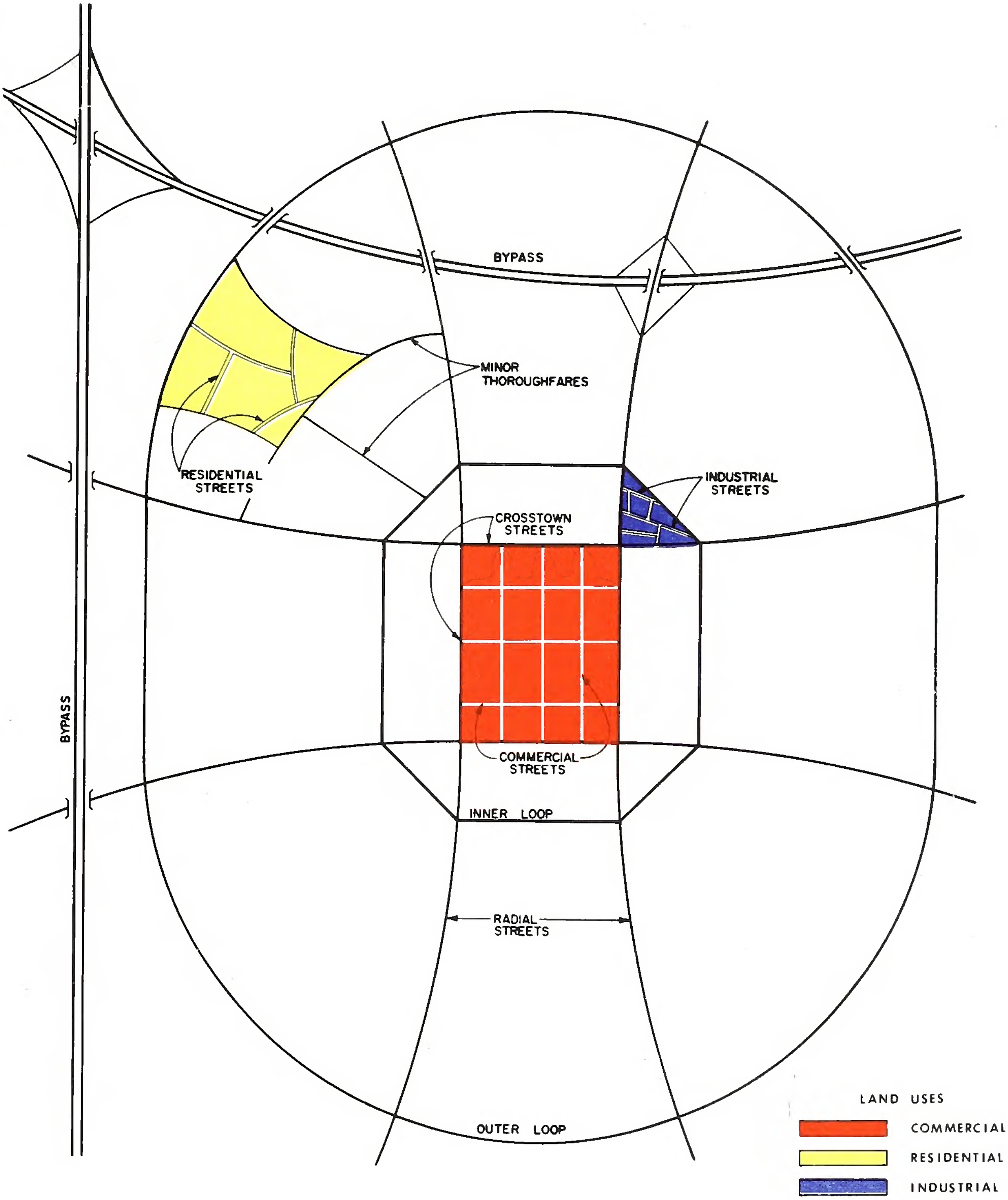


FIGURE 13

APPENDICES

APPENDIX A
Thoroughfare Plan Street Tabulation and Recommendations

FACILITY AND SECTION	EXISTING CROSS-SECTION ENGLISH UNITS DIST MI	RDY FT	ROW FT	S.I. UNITS DIST KM	RDWY M	ROW M	NUMBER OF LANES	PRACTICAL CAPACITY CURRENT (FUTURE)	1993 ADTS	2020 ADTS	RECOMMENDED X - SECTION RDWAY (ULT)	2020 ADT
US 117 BYPASS												
Southern PAB - NC 55 In.	2.50	56	200	4.03	17.07	60.97	4	28,000	5,500	9,600	ADQ	9,500
Interchange Area	0.44	48	200	0.71	14.63	60.97	4	28,000	6,800	9,700	ADQ	8,000
NC 55 Int. - North PAB	1.18	48	200	1.90	14.63	60.97	4	28,000	7,500	15,000	ADQ	15,000
US 117 BUSINESS (BREAZEALE AVENUE)												
SPB - SR 1144	1.06	20	100	1.71	6.09	30.49	2	7,800	2,700	5,700	L	5,200
SR 1144 - Pollock St.	0.81	21	100	1.31	6.40	30.49	2	8,700	5,400	5,700	I	5,700
Pollock St. - Main St.	0.10	25	100	0.16	7.62	30.49	2	11,600	5,400	5,900	I	5,700
Main St. - Station St.	0.32	25	100	0.52	7.62	30.49	2	11,600	6,400	10,200	I	8,400
Station Street - NC 55	0.78	52	100	1.26	15.85	30.49	5	28,000	12,600	11,600	ADQ	11,000
NC 55 - SR 1941	0.47	30	100	0.76	9.15	30.49	3	18,900	5,800	8,800	ADQ	8,800
SR 1941 - Northern PAB	0.87	20	100	1.40	6.09	30.49	2	7,800	5,200	8,800	I	8,800
NC 55												
WPB - US 117 BYPASS	1.70	24	150	2.74	7.32	45.73	2	10,400	3,700	7,400	ADQ	5,900
US 117 BYP - US 117 BUS	0.28	48	150	0.45	14.63	45.73	4	28,000	7,700	16,600	ADQ	16,200
US 117 BUS - EAST PAB	1.63	22	150	2.63	6.71	45.73	2	8,000	3,500	4,200	ADQ	4,200

PAB - PLANNING AREA BOUNDARY
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CENTER STREET												
Park Ave. - College St.	0.33	24	130	0.53	7.32	39.63	2	10,400	1,100	2,600	ADQ	1,100
College St. - Main St.	0.25	72	130	0.40	21.95	39.63	2	9,600	1,400	1,200	ADQ	1,100
Main St. - Pollock St.	0.09	74	130	0.15	22.56	39.63	2	9,600	1,400	1,000	ADQ	900
CHURCH ST./SEVEN SPRINGS												
SR 1947 - Oliver St.	0.87	18	VAR	1.40	5.49	VAR	2	5,800	2,100	2,700	ADQ	1,400
Oliver St. - Main St.	0.18	18	50	0.29	5.49	15.25	2	5,800	2,100	2,000	ADQ	1,400
Main St. - College St.	0.20	23	50	0.32	7.01	15.25	2	10,700	2,200	3,500	ADQ	3,500
College St. - Journey	0.23	20	50	0.37	6.09	15.25	2	7,800	2,100	2,600	ADQ	2,600
Journey St. - North CL	0.42	20	90	0.68	6.09	27.44	2	7,800	1,300	1,400	ADQ	1,400
North CL - NC 55	0.68	20	90	1.10	6.09	27.44	2	7,800	400	450	ADQ	600
OUTER LOOP												
Smith Chapel - US 117	0.52	24	100	0.84	7.32	30.49	2	12,100	---	---	L	10,200
US 117 BYP - SR 1947	1.46	24	100	2.35	7.32	30.49	2	12,100	---	---	L	10,800
SR 1947 - Oliver St.	0.49	24	100	0.79	7.32	30.49	2	12,100	---	---	L	9,800
Oliver St. - James St.	0.76	24	100	1.23	7.32	30.49	2	12,100	---	--	L	7,200
James St. - Seven Sprg.	0.97	24	100	1.56	7.32	30.49	2	12,100	---	---	L	11,200

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JAMES STREET (SR 1004)												
Wooten St. - Southerland	0.18	21		0.29	6.40		2	8,700	350	450	L	2,900
Southerland - Breazeale	0.08	26		0.13	7.93		2	11,600	1,700	2,100	ADQ	2,900
Breazeale - Center St.	0.18	26		0.29	7.93		2	11,600	1,700	2,300	ADQ	2,900
Center St. - Church St.	0.13	18		0.21	5.49		2	5,800	1,700	2,300	L	2,900
Church St. - Main St.	0.34	18		0.55	5.49		2	4,800	3,000	4,900	L	2,300
Main St. - East CL	0.37	20	50	0.60	6.10	15.25	2	6,800	3,000	5,600	L	2,300
East CL - East PAB	0.85	20	60	1.37	6.10	18.29	2	7,800	2,800	5,600	L	5,600
MAIN STREET												
US 117 Byp - Smith Chap	0.37	28	50	0.60	8.54	15.25	2	12,000	3,400	6,600	ADQ	5,400
Smith Chap - Breazeale	0.25	26	50	0.40	7.93	15.25	2	11,600	2,800	4,400	ADQ	3,000
Breazeale St. - Center	0.18	28	50	0.29	8.54	15.25	2	11,000	2,200	4,600	ADQ	3,000
Center St. - Church St.	0.14	28	50	0.23	8.54	15.25	2	11,000	2,200	3,600	ADQ	3,000
Church St. - James St.	0.37	18	50	0.60	5.49	15.25	2	5,800	1,300	3,600	L	3,000
PARK AVENUE												
Church St. - Breazeale	0.40	20	50	0.65	6.10	15.25	2	7,800	2,600	2,800	ADQ	2,800

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SMITH CHAPEL HIGHWAY												
US 117 Bypass - Crest Dr	0.09	24	60	0.15	7.32	18.29	2	11,600	1,300	1,900	ADQ	1,800
Crest Dr. - Main Street	0.72	18	60	1.16	5.49	18.29	2	5,800	1,300	1,400	ADQ	1,100
WILLIAMSON STREET												
Smith Chapel - Martin St	0.27	18	50	0.44	5.49	15.24	2	4,800	500	1,200	ADQ	1,200
Martin St. - Southerland	0.08	24	50	0.13	7.32	15.24	2	10,600	500	1,200	ADQ	1,200
Southerland - Center St.	0.25	32	50	0.40	9.76	15.24	2	11,000	230	1,200	ADQ	1,200
JONES GROVE CHURCH ROAD (SR 1135)												
West PAB - NC 55	0.70	18	60	1.13	5.49	18.29	2	5,800	1,000	680	ADQ	650
NC 55 - SR 1141	0.40	18	60	0.65	5.49	18.29	2	5,800	1,000	800	ADQ	270
WEST MAIN ST. (SR 1141)												
NC 55 - US 117 Bypass	0.67	18	60	1.08	5.49	18.29	2	5,800	400	550	ADQ	230
DOUGHTERY FIELD RD. (SR 1143)												
SOUTH PB - Outer Loop	0.50	26	60	0.81	7.93	18.29	2	Unpaved	40	50	OLoop	---
Outer Loop - SR 1147	0.38	18	60	0.61	5.49	18.29	2	5,800	90	120	ADQ	120

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LEE'S COUNTRY CLUB RD. (SR 1144)												
Outer Loop - Breazeale	0.65	20	60	1.05	6.10	18.29	2	5,800	650	700	ADQ	3,000
MARTIN ROAD (SR 1146)												
West PAB - NC 55	0.90	18	60	1.45	5.49	18.29	2	5,800	950	1,000	ADQ	900
OLD SMITH CHAPEL RD. (SR 1147)												
West PAB - US 117 Bypass	0.85	20	60	1.37	6.10	18.29	2	7,800	1,000	1,700	ADQ	1,700
BEAUTANCUS RD. (SR 1306)												
Wayne County - East PAB	1.00	18	60	1.61	5.49	18.29	2	7,800	1,000	1,700	6.1m	1,700
MOUNT GILEAD CHURCH RD. (SR 1318)												
SR 1306 - SPB	0.93	18		1.50	5.49		2	5,800	290	400	ADQ	400
PARK AVENUE (SR 1744)												
SR 1941 - NC 55	0.75	18	60	1.21	5.49	18.29	2	5,800	1,700	3,200	ADQ	3,200
NC 55 - Seven Springs Rd	0.16	18	60	0.26	5.49	18.29	2	5,800	1,700	3,200	L	11,200
NORTHEAST CHURCH RD. (SR 1941)												
US 117 BUS - Park Avenue	2.23	18		3.60	5.49		2	5,800	1,600	2,900	6.7m	2,900

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	DIST MI	RDY FT	ROW FT	DIST KM	RDWY M	ROW M					RDWAY (ULT)	2020 ADT
TALTON STREET (SR 1942) Center St. - Breazeale	0.40	20		0.65	6.10		2	7,800	950	1,200	ADQ	1,200
OLD COUNTY RD. (SR 1946) Wayne County - Oliver St	0.41	18	50	0.66	5.49	15.24	2	5,800	900	1,500	ADQ	1,500
COUNTY ROAD (SR 1947) Breazeale - Wayne County	0.58	18		0.94	5.49		2	5,800	1,400	1,600	ADQ	1,600
OLIVER STREET Old County Rd. - Church	0.30	18	50	0.48	5.49	15.24	2	5,800	230	850	ADQ	700
GORDON STREET Main Street - Oliver St.	0.25	16		0.40	4.88		2	3,900	240	700	ADQ	700
HENDERSON STREET Breazeale St. - Center	0.15	18		0.24	5.49		2	5,800		2,300	ADQ	3,300

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Appendix B

TYPICAL THOROUGHFARE CROSS SECTIONS

Cross section requirements for thoroughfares vary according to the desired capacity and level of service to be provided. Universal standards in the design of thoroughfares are not practical. Each street section must be individually analyzed and its cross section requirements determined on the basis of amount and type of projected traffic, existing capacity, desired level of service, and available right-of-way.

Typical cross section recommendations are shown in Figure B-3. These cross sections are typical for facilities on new location and where right-of-way constraints are not critical. For widening projects and urban projects with limited right-of-way, special cross sections should be developed that meet the needs of the project.

Recommended typical cross sections for thoroughfares were derived on the basis of projected traffic, existing capacities, desirable levels of service, and available right-of-way. The recommended typical cross sections for the thoroughfares are given in Appendix A along with other pertinent information.

On all existing and proposed major thoroughfares delineated on the thoroughfare plan, adequate right-of-way should be protected or acquired for the ultimate cross sections. Ultimate desirable cross sections for each of the thoroughfares are listed in Appendix A. Recommendations for "ultimate" cross sections are provided for (1) thoroughfares which may require widening after the current planning period; (2) for thoroughfares which are borderline adequate and accelerated traffic growth could render them deficient; and (3) for thoroughfares where an urban curb and gutter cross section may be locally desirable because of urban development or redevelopment.

Recommended design standards relating to maximum and minimum grades, minimum sight distances, maximum degree of curve and related super elevation, and other considerations for thoroughfares are given in Appendix C. This Appendix gives definitions and design standards recommended for inclusion in subdivision regulations.

Cross section "A" is typical for controlled access freeways. The 14 m (46 ft) grassed median is the minimum desirable median width, but there could be some variation from this depending upon design considerations. Right-of-way requirements would typically vary upward from 70 m (228 ft) depending upon cut and fill requirements.

Cross section "B" is typical for four lane divided highways in rural areas which may have only partial or no control of access. The minimum median width for this cross section is 14 m (46 ft), but a wider median is desirable. Design requirements for slopes and drainage would be similar to cross section "A", but there may be some variation from this depending upon right-of-way constraints.

Cross section "C", seven lane urban, should not be used for new projects. When the conditions warrant six lanes, cross section "E" should be recommended. Cross section "C" should be used only in special situations such as when widening from a five lane section and right-of-way is limited. Even in these situations, consideration should be given to converting the center turn lane to a median so that cross section "E" is the final cross section.

Cross section "D", five lane urban, is typical for major thoroughfares where frequent left turns are anticipated as a result of abutting development or frequent street intersections.

Cross sections "E" and "F" are used on major thoroughfares where left turns and intersecting streets are not as frequent. Left turns would be restricted to a few selected intersections. The 4.8 m (16 ft) median is the minimum recommended for an urban boulevard type cross section. In most instances, monolithic construction should be utilized due to greater cost effectiveness, ease and speed of placement, and reduced future maintenance requirements. In special cases, grassed or landscaped medians may be used in urban areas. However, these types of medians result in greatly increased maintenance costs and an increased danger to maintenance personnel. Non-monolithic medians should only be recommended when the above concerns are addressed.

Cross section "G" is recommended for urban boulevards or parkways to enhance the urban environment and to improve the compatibility of major thoroughfares with residential areas. A minimum median width of 7.3 m (24 ft) is recommended with 9.1 m (30 ft) being desirable.

Typical cross section "H" is recommended for major thoroughfares where projected travel indicates a need for four travel lanes but traffic is not excessively high, left turning movements are light, and right-of-way is restricted. An additional left turn lane would probably be required at major intersections. This cross section should be used only if the above criteria is met. If right-of-way is not restricted, future strip development could take place and the inner lanes could become de facto left turn lanes.

In urban environments, thoroughfares which are proposed to function as one-way traffic carriers would typically require

cross section "I". Cross sections "J" and "K" are usually recommended for urban minor thoroughfares since these facilities usually serve both land service and traffic service functions. Cross section "J" would be used on those minor thoroughfares where parking on both sides is needed as a result of more intense development.

Cross section "L" is used in rural areas or for staged construction of a wider multi-lane cross section. On some thoroughfares, projected traffic volumes may indicate that two travel lanes will adequately serve travel for a considerable period of time. For areas that are growing and future widening will be necessary, the full right-of-way of 30 m (100 ft) should be required. In some instances, local ordinances may not allow the full 30 m (100 ft). In those cases, 21 m (70 ft) should be preserved with the understanding that the full 30 m (100 ft) will be preserved by use of building setbacks and future street line ordinances.

The urban curb and gutter cross sections all illustrate the sidewalk adjacent to the curb with a buffer or utility strip between the sidewalk and the minimum right-of-way line. This permits adequate setback for utility poles. If it is desired to move the sidewalk farther away from the street to provide additional separation for pedestrians or for aesthetic reasons, additional right-of-way must be provided to insure adequate setback for utility poles.

The right-of-ways shown for the typical cross sections are the minimum rights-of-way required to contain the street, sidewalks, utilities, and drainage facilities. Cut and fill requirements may require either additional right-of-way or construction easements. Obtaining construction easements is becoming the more common practice for urban thoroughfare construction.

If there is sufficient bicycle travel along the thoroughfare to justify a bicycle lane or bikeway, additional right-of-way may be required to contain the bicycle facilities. The North Carolina Bicycle Facilities Planning and Design Guidelines should be consulted for design standards for bicycle facilities. Cross sections O, P, and Q are typically used to accommodate bicycle travel.

TYPICAL THOROUGHFARE CROSS SECTIONS

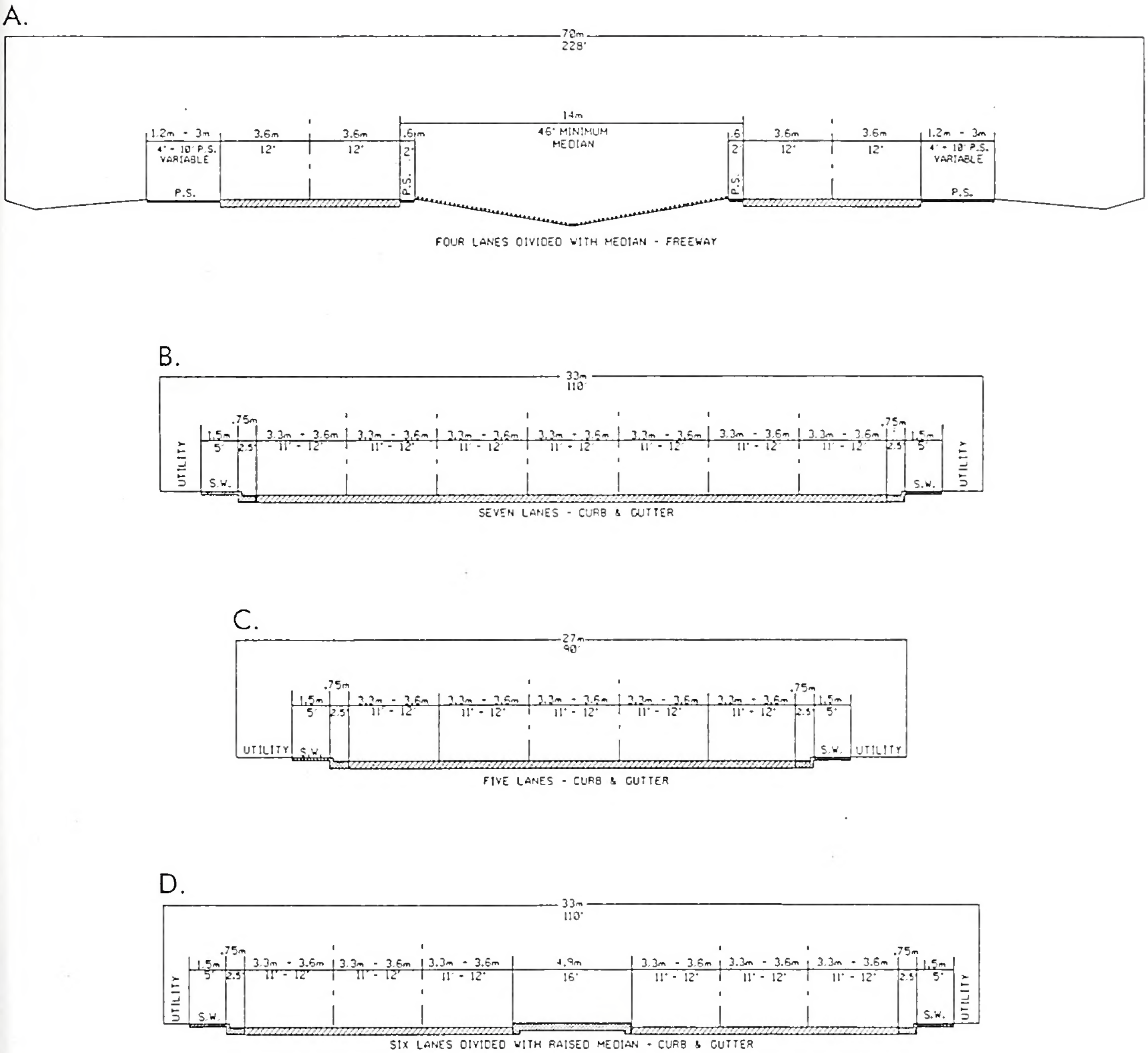
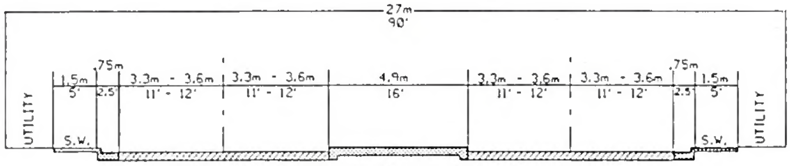


FIGURE 14

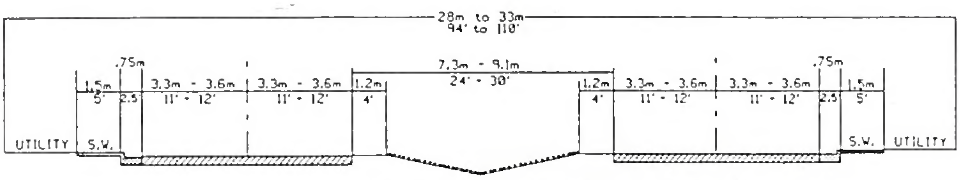
TYPICAL THOROUGHFARE CROSS SECTIONS

E.



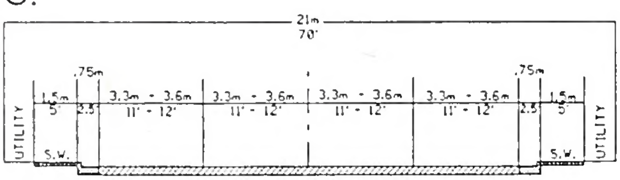
FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

F.



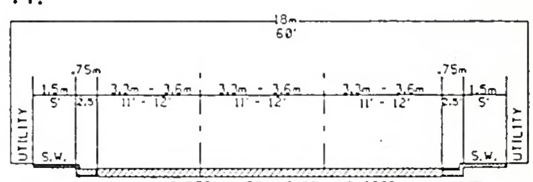
FOUR LANES DIVIDED - BOULEVARD
GRASS MEDIAN

G.



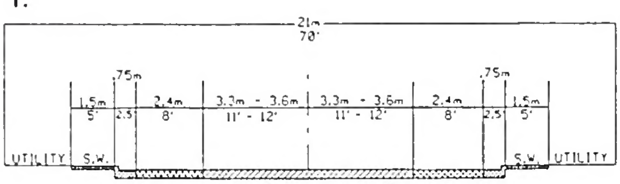
FOUR LANES - CURB & GUTTER

H.



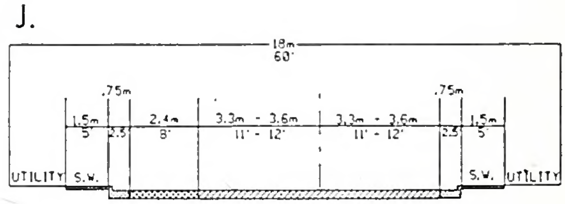
THREE LANES - CURB & GUTTER

I.



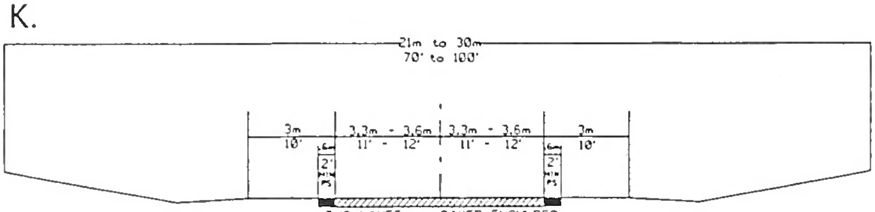
TWO LANES - CURB & GUTTER
PARKING ON EACH SIDE

J.



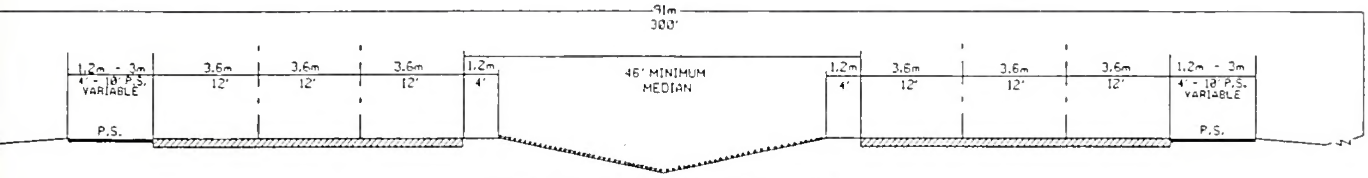
TWO LANES - CURB & GUTTER
PARKING ON ONE SIDE

K.



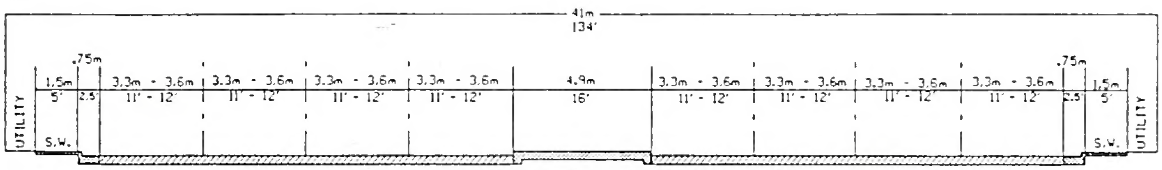
TWO LANES - PAVED SHOULDER

TYPICAL THOROUGHFARE CROSS SECTIONS



SIX LANES DIVIDED WITH GRASS MEDIAN - FREEWAY

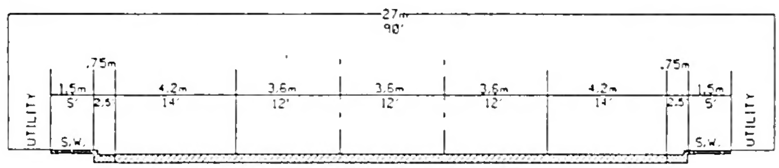
M.



EIGHT LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

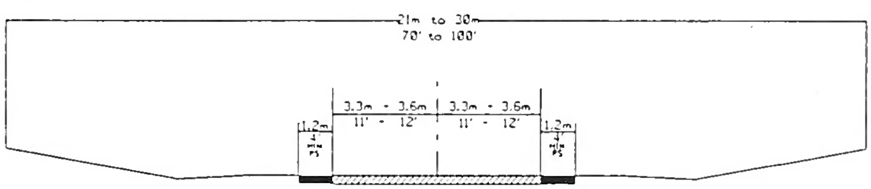
TYPICAL THOROUGHFARE CROSS SECTIONS FOR ACCOMMODATING BICYCLES

N.



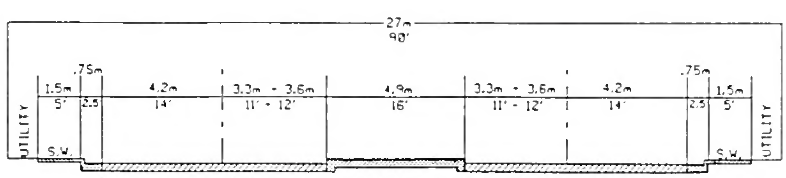
FIVE-LANE ROADWAY WITH CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES

O.



TWO LANES - SHOULDER SECTION

P.



FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES

Appendix C

RECOMMENDED SUBDIVISION ORDINANCES

DEFINITIONS

I. Streets and Roads

A. Rural Roads

1. Principal Arterial - A rural link in a highway system serving travel, and having characteristics indicative of substantial statewide or interstate travel and existing solely to serve traffic. This network would consist of Interstate routes and other routes designated as principal arterials.

2. Minor Arterial - A rural roadway joining cities and larger towns and providing intra-state and inter-county service at relatively high overall travel speeds with minimum inter-ference to through movement.

3. Major Collector - A road which serves major intra-county travel corridors and traffic generators and provides access to the Arterial system.

4. Minor Collector - A road which provides service to small local communities and traffic generators and provides access to the Major Collector system.

5. Local Road - A road which serves primarily to provide access to adjacent land, over relatively short distances.

B. Urban Streets

1. Major Thoroughfares - Major thoroughfares consist of Inter-state, other freeway, expressway, or parkway roads, and major streets that provide for the expeditious movement of high volumes of traffic within and through urban areas.

2. Minor Thoroughfares - Minor thoroughfares perform the function of collecting traffic from local access streets and carrying it to the major thoroughfare system. Minor thoroughfares may be used to supplement the major thorough-fare system by facilitating minor through-traffic movements and may also serve abutting property.

3. Local Street - A local street is any street not on a higher order urban system and serves primarily to provide direct access to abutting land.

C. Specific Type Rural or Urban Streets

1. Freeway, expressway, or parkway - Divided multilane road-ways designed to carry large volumes of traffic at high speeds. A freeway provides for continuous flow of vehicles with no direct access to abutting property and with access to selected crossroads only by way of interchanges. An expressway is a facility with full or partial control of access and generally with grade separations at major inter-sections. A parkway is for non-commercial traffic, with full or partial control of access.

2. Residential Collector Street - A local street which serves as a connector street between local residential streets and the thoroughfare system. Residential collector streets typically collect traffic from 100 to 400 dwelling units.

3. Local Residential Street - Cul-de-sacs, loop streets less than 750 meters in length, or streets less than one and a half kilometers in length that do not connect thoroughfares, or serve major traffic generators, and do not collect traffic from more than 100 dwelling units.

4. Cul-de-sac - A short street having only one end open to traffic and the other end being permanently terminated and a vehicular turn-around provided.

5. Frontage Road - A road that is parallel to a partial or full access controlled facility and provides access to adjacent land.

6. Alley - A strip of land, owned publicly or privately, set aside primarily for vehicular service access to the back side of properties otherwise abutting on a street.

II. Property

A. Building Setback Line - A line parallel to the street in front of which no structure shall be erected.

B. Easement - A grant by the property owner for use by the public, a corporation, or person(s), of a strip of land for a specific purpose.

C. Lot - A portion of a subdivision, or any other parcel of land, which is intended as a unit for transfer of ownership or for development or both. The word "lot" includes the words "plat" and "parcel".

III. Subdivision

A. Subdivider - Any person, firm, corporation or official agent thereof, who subdivides of develops any land deemed to be a subdivision.

B. Subdivision - All divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, immediate or future, of sale or building development and all divisions of land involving the dedication of a new street or change in existing streets; provided, however, that the following shall not be included within this definition nor subject to these regulations: (1) the combination or re-combination of portions of previously platted lots where the total number of lots is not increased and the resultant lots are equal to or exceed the standards contained herein; (2) the division of land into parcels greater than four hectares where no street right-of-way dedication is involved, (3) the public acquisition, by purchase, of strips of land for the widening or the opening of streets; (4) the division of a tract in single ownership whose entire area is no greater than 0.8 hectares into not more than three lots, where no street right-of-way dedication is involved and where the resultant lots are equal to or exceed the standards contained herein.

C. Dedication - A gift, by the owner, of his property to another party without any consideration being given for the transfer. The dedication is made by written instrument and is completed with an acceptance.

D. Reservation - Reservation of land does not involve any trans-fer of property rights. It constitutes an obligation to keep property free from development for a stated period of time.

DESIGN STANDARDS

I. Streets and Roads

The design of all roads within the Planning Area shall be in accordance with the accepted policies of the North Carolina Department of Transportation, Division of Highways, as taken or modified from the American Association of State Highway Officials' (AASHTO) manuals.

The provision of street rights-of-way shall conform and meet the recommendations of the Thoroughfare Plan, as adopted by the municipality.

The proposed street layout shall be coordinated with

the existing street system of the surrounding area. Normally the proposed streets should be the extension of existing streets if possible.

A. Right-of-way Widths - Right-of-way (ROW) widths shall not be less than the following and shall apply except in those cases where ROW requirements have been specifically set out in the Thoroughfare Plan.

	Min. ROW
1. Rural	
a. Principle Arterial	
Freeways	105 meters
Other	60 meters
b. Minor Arterial	30 meters
c. Major Collector	30 meters
d. Minor Collector	24 meters
e. Local Road	18 meters[1]
2. Urban	
a. Major Thoroughfare other than Freeway and Expressway	27 meters
b. Minor Thoroughfare	21 meters
c. Local Street	18 meters[1]
d. Cul-de-sac	Variable[2]

The subdivider will only be required to dedicate a maximum of 30 meters of right-of-way. In cases where over 30 meters of right-of-way is desired, the subdivider will be required only to reserve the amount in excess of 30 meters. On all cases in which right-of-way is sought for a fully controlled access facility, the subdivider will only be required to make a reservation. It is strongly recommended that subdivisions provide access to properties from internal streets, and that direct property access to major thoroughfares, principle and minor arterials, and major collectors be avoided. Direct property access to minor thoroughfares is also undesirable.

A partial width right-of-way, not less than eighteen meters in width, may be dedicated when adjoining undeveloped property that is owned or controlled by the

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[1] The desirable minimum right-of-way (ROW) is 18 meters. If curb and gutter is provided, 15 meters of ROW is adequate on local residential streets.

[2] The ROW dimension will depend on radius used for vehicular turn around. Distance from edge of pavement of turn around to ROW should not be less than distance from edge of pavement to ROW on street approaching turn around.

subdivider; provided that the width of a partial dedication be such as to permit the installation of such facilities as may be necessary to serve abutting lots. When the said adjoining property is sub-divided, the remainder of the full required right-of-way shall be dedicated.

B. Street Widths - Widths for street and road classifications other than local shall be as recommended by the Thoroughfare Plan. Width of local roads and streets shall be as follows:

1. Local Residential
   - Curb and Gutter section: 7.8 meters, face to face of curb
   - Shoulder section: 6 meters to edge of pavement, 1.2 meters for shoulders

2. Residential Collector
   - Curb and Gutter section: 10.2 meters, face to face of curb
   - Shoulder section: 6 meters to edge of pavement, 1.8 meters for shoulders

C. Geometric Characteristics - The standards outlined below shall apply to all subdivision streets proposed for addition to the State Highway System or Municipal Street System. In cases where a subdivision is sought adjacent to a proposed thoroughfare corridor, the requirements of dedication and reservation discussed under Right-of-Way shall apply.

1. Design Speed - The design speed for a roadway should be a minimum of 10 km/h greater than the posted speed limit. The design speeds for subdivision type streets shall be:

DESIGN SPEEDS			
Facility Type	Design Speed km/h		
	Desirable	Minimum	
		Level	Rolling
RURAL			
Minor Collector Roads	100	80	70
Local roads including Residential Collectors and Local Residential	80	80	70
URBAN			
Major Thoroughfares other than Freeway or Expressway	100	80	80
Minor Thoroughfares	100	80	70
Local Streets	70	70	50

2. Maximum and Minimum Grades

a. The maximum grades in percent shall be:

MAXIMUM VERTICAL GRADE				
Facility Type	Design Speed (km/h)	Maximum Grade (Percent) Flat	Rolling	Mountainous
RURAL				
Minor Collector Roads*	30	7	10	12
	50	7	9	10
	60	7	8	10
	90	6	7	9
	100	5	6	8
	110	4	5	6
Local roads including Residential Collectors and Local Residential Streets*	30	–	11	16
	50	7	10	14
	60	7	9	12
	90	6	8	10
	100	5	6	–
URBAN				
Major Thoroughfares other than Freeway or Expressway	50	8	9	11
	60	7	8	10
	90	6	7	9
	100	5	6	8
Minor Thoroughfares*	30	9	10	12
	50	9	9	10
	60	9	8	10
	90	7	7	9
	100	6	6	8
	110	5	5	6
Local Streets*	30	–	12	17
	50	8	11	15
	60	8	10	13
	90	7	9	11
	100	6	7	–

b. Minimum grade should not be less than 0.5% .

c. Grades for 30 meters each way from intersections (measured from edge of pavement) should not exceed 5%.

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* For streets and roads with projected annual average daily traffic less than 250 or short grades less than 150 meters long, grades may be 2% steeper than the values in the above table.

3. Minimum Sight Distance - In the interest of public safety, no less than the minimum sight distance applicable shall be provided. Vertical curves that connect each change in grade shall be provided and calculated using the following parameters:

SIGHT DISTANCE					
Design Speed (km/h)	30	50	60	90	100
Stopping Sight Distance					
Minimum (meters)	30	60	80	140	160
Desirable Minimum (meters)	30	70	90	170	210
Minimum K* Value for:					
Crest curve	3	10	18	71	105
Sag curve	4	12	18	40	51

(General practice calls for vertical curves to be multiples of 10 meters. Calculated lengths shall be rounded up in each case.)

4. The "Superelevation Table" shown below and continued on the next page shows the minimum radius and the related maximum superelevation for design speeds. The maximum rate of roadway superelevation (e) for rural roads with no curb and gutter is 0.08. The maximum rate of superelevation for urban streets with curb and gutter is 0.06, with 0.04 being desirable.

SUPERELEVATION TABLE		
Design Speed (km/h)	Maximum e	Minimum Radius (meters)
50	0.04	100
60	0.04	150
90	0.04	375
100	0.04	490

* K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length in meters of the vertical curve which will provide the desired sight distance. Sight distance provided for stopped vehicles at intersections should be in accordance with "A Policy on Geometric Design of Highways and Streets, 1990".

SUPERELEVATION TABLE continued		
Design Speed (km/h)	Maximum e	Minimum Radius (meters)
50	0.06	90
60	0.06	135
90	0.06	335
100	0.06	435
50	0.08	80
60	0.08	125
90	0.08	305
100	0.08	395

e = rate of roadway superelevation, meter per meter

D. Intersections

1. Streets shall be laid out so as to intersect as nearly as possible at right angles, and no street should intersect any other street at an angle less than sixty-five (65) degrees.

2. Property lines at intersections should be set so that the distance from the edge of pavement, of the street turnout, to the property line will be at least as great as the distance from the edge of pavement to the property line along the intersecting streets. This property line can be established as a radius or as a sight triangle. Greater offsets from the edge of pavement to the property lines will be required, if necessary, to provide sight distance for the stopped vehicle on the side street.

3. Off-set intersections are to be avoided. Intersections which cannot be aligned should be separated by a minimum length of 60 meters between survey centerlines.

E. Cul-de-sacs

Cul-de-sacs shall not be more than one hundred and fifty (150) meters in length. The distance from the edge of pavement on the vehicular turn around to the right-of-way line should not be less than the distance from the edge of pavement to right-of-way line on the street approaching the turn around. Cul-de-sacs should not be used to avoid connection with an existing street or to avoid the extension of an important street.

F. Alleys

1. Alleys shall be required to serve lots used for commercial and industrial purposes except that this requirement may be waived where other definite and assured provisions are made for service access. Alleys shall not be provided in residential subdivisions unless necessitated by unusual circumstances.

2. The width of an alley shall be at least six (6) meters.

3. Deadend alleys shall be avoided where possible, but if unavoidable, shall be provided with adequate turn around facilities at the deadend as may be required by the Planning Board.

G. Permits For Connection To State Roads

An approved permit is required for connection to any existing state system road. This permit is required prior to any construction on the street or road. The application is available at the office of the District Engineer of the Division of Highways.

H. Offsets To Utility Poles

Poles for overhead utilities should be located clear of roadway shoulders, preferably a minimum of at least 9 meters from the edge of pavement. On streets with curb and gutter, utility poles shall be set back a minimum distance of 1.8 meters from the face of curb.

I. Wheel Chair Ramps

All street curbs being constructed or reconstructed for maintenance purposes, traffic operations, repairs, correction of utilities, or altered for any reason, shall provide wheelchair ramps for the physically handicapped at intersections where both curb and gutter and sidewalks are provided and at other major points of pedestrian flow.

J. <u>Horizontal Width on Bridge Deck</u>

1. The clear roadway widths for new and reconstructed bridges serving 2 lane, 2 way traffic should be as follows:

   a. Shoulder section approach

      i. Under 800 ADT design year

         Minimum 8.4 meters width face to face of parapets, rails, or pavement width plus 3 meters, whichever is greater.

      ii. 800 - 2000 ADT design year

         Minimum 10.2 meters width face to face of parapets, rails, or pavement width plus 3.6 meters, whichever is greater.

      iii. Over 2000 ADT design year

         Minimum width of 12 meters, desirable width of 13.2 meters width face to face of parapets or rails.

   b. Curb and gutter approach

      i. Under 800 ADT design year

         Minimum 7.2 meters face to face of curbs.

      ii. Over 800 ADT design year

         Width of approach pavement measured face to face of curbs.

         Where curb and gutter sections are used on roadway approaches, curbs on bridges shall match the curbs on approaches in height, in width of face to face of curbs, and in crown drop. The distance from face of curb to face of parapet or rail shall be a minimum of 450 millimeters, or greater if sidewalks are required.

2. The clear roadway widths for new and reconstructed bridges having 4 or more lanes serving undivided two-way traffic should be as follows:

   a. Shoulder section approach - Width of approach pavement plus width of usable shoulders on the approach left and right. (Shoulder width 2.4 m minimum, 3 m desirable.)

   b. Curb and gutter approach - Width of approach pavement measured face to face of curbs.

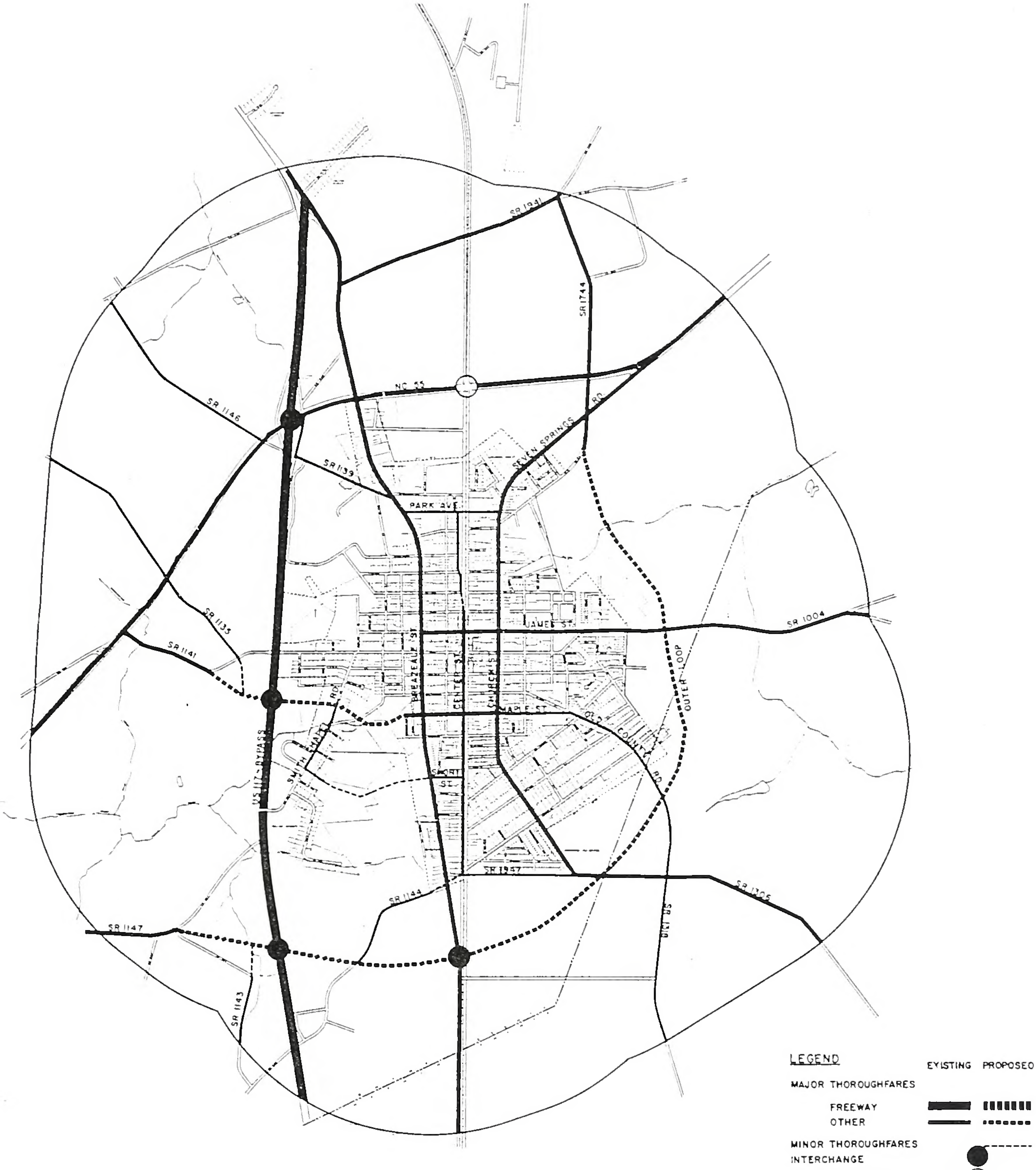
CONVERSION TABLE			
English Units		S.I. Units	Abreviation
1 inch	equals	25 millimeters	(mm)
1 foot	equals	0.3 meters	(m)
1 mile	equals	1.6 kilometers	(km)
1 acre	equals	2.47 hectares	(hect)

METRIC EQUIVALENTS		
1 millimeter	equals	0.001 meters
1 kilometer	equals	1000 meters
1 hectare	equals	10,000 square meters

Appendix D

Planning Area Housing and Employment Data

ZONE	1993 Employment	2020 Employment	1993 Housing	2020 Housing
1	358	358	45	145
2	309	439	176	256
3	25	25	30	70
4	0	0	4	19
5	0	0	6	11
6	10	10	79	84
7	0	0	66	71
8	0	0	17	25
9	5	5	10	18
10	0	10	14	29
11	213	238	8	13
12	884	884	24	29
13	15	15	101	141
14	95	120	0	0
15	90	90	5	8
16	40	40	6	6
17	0	0	29	29
18	10	10	129	159
19	280	280	128	143
20	111	111	0	2
21	97	97	30	30
22	20	20	29	34
23	40	65	103	153
24	0	0	120	195
25	70	85	114	129
26	61	61	9	9
27	35	35	239	279
28	36	36	413	488
29	0	0	16	76
30	0	35	0	0



ADOPTED BY MOUNT OLIVE__________
RECOMMENED APPROVAL BY PLANNING AND RESEARCH DEPARTMENT__________
ADOPTED BY NORTH CAROLINA STATE HIGHWAY COMMISSION__________

THOROUGHFARE PLAN
MOUNT OLIVE
JUNE 7, 1972

FIGURE 4

THOROUGHFARE PLAN COOPERATIVELY DEVELOPED BY COMMUNITY SERVICES DIVISION, NORTH CAROLINA DEPARTMENT OF NATURAL AND ECONOMIC RESOURCES AND PLANNING AND RESEARCH DEPARTMENT, NORTH CAROLINA STATE HIGHWAY COMMISSION.

FIGURE 15